Market Power in Nigerian Domestic Cocoa Supply Chain

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All errors, however, are mine.

Abstract

An efficient and integrated cocoa market in Nigeria is important if the nation is going to successfully compete with regional cocoa producers such as Cote d'Ivoire and Ghana in the international markets. At present, Nigeria produces just about 6% of the global production, while Cote d'Ivoire produces about 43% and Ghana 14%. This study, therefore, is an attempt to examine whether cocoa market liberalization reform in Nigeria has achieved its stated objective of increasing the efficiency of the cocoa supply chain. A common indicator of efficient and functioning markets is the presence of high level of integration among them; while lack of integration could be an indication of private traders' market power tendency. The analyses are based on annual aggregate and monthly cocoa price data and done within error correction and cointegration model framework. The results indicate both vertical and horizontal integration of various markets along Nigerian cocoa supply chain. In specific terms, the results show that (i) there is no tendency towards non-competitive behaviour by major cocoa exporters in Nigeria who now interface between the world and domestic cocoa markets, and (ii) export price series closely follows world price series, while farm gate price closely follows export in the long run. In addition, the source markets are well integrated. The speed of adjustment towards long-run equilibrium, however, varies with the position of the market along the supply chain.

Key words: *Agricultural Policy, Market Structure, Cocoa, Cointegration, Nigeria*

JEL Codes: C01, D4, Q13, Q18, L66

1. Introduction

A key objective of the International Monetary Fund (IMF) and the World Bank assisted Structural Adjustment Programme (SAP) implemented in Nigeria, as well as most sub-Sahara African nations since the mid1980s, was the elimination of barriers to trade. Before then, marketing of most major export and food commodities was highly regulated through input price controls and subsidies, monopsonistic produce marketing boards, and fixed producer prices. Commodity prices were generally set below market levels by governments, implicitly taxing producers while subsidizing consumers (Barrett and Mutambatsere, 2005). Policy instruments, such as import tariffs, quotas, and export subsidies or taxes, intervention mechanisms, as well as exchange rate policies, insulate the domestic markets and hinder full transmission of international price signals by affecting the excess demand or supply schedules of domestic commodity markets (Mundlak and Larson, 1992; Baffes and Ajwad, 2001; Varangis and Shreiber, 2001; Sharma, 2002).

With the assistance of the World Bank and the IMF Structural Adjustment Programme (SAP) was launched in Nigeria in 1986. Key reforms implemented by the governments of the Federal Republic of Nigeria within the free market approach include: institutional reforms and privatization, which recognized the role of the private sector in sustaining agriculture-based exporting and processing activities; inflation control and the conduct of monetary policy. Others include liberalization of the exchange rate, export credits and expansion grants, and liberalization of trade in agricultural inputs and outputs. These measures were intended to increase farmers' income and to strengthen the efficiency of export marketing channel by establishing competition between the exporting companies. This study is an effort to examine whether this objective has been achieved in the case of cocoa in Nigeria. The new policy is expected to increase transmission of world signals to local producers if the discrepancies between the world price and the producer prices are reduced. This, however, depends on how exporting firms, who now assumes the roles of the monopolistic marketing board, manage post-liberalization challenges that may hinder integration.

With these points in mind, the central research hypothesis is that: Is there evidence that exporting firms have significant tendency to exert market power over cocoa farmers by transmitting price changes on export market inefficiently? Meyer and Von Cramon-Taubadel (2004) consider market power as one of the primary potential cause of vertical asymmetric price transmission. Therefore, the aim of the study is to examine whether the cocoa markets in Nigeria are efficient in post-liberalization period and the basic null hypotheses, is that cocoa exporting firms in Nigeria have no significant

tendency towards non-competitive behaviour. This paper proceeds as follows; some basic information on the structure of Nigerian cocoa market is provided in section 2. The existing conceptual framework and empirical literature review is presented in section 3, while the dataset and model used are discussed in section 4. The empirical results and discussions are presented in section 5, while the summary and conclusion are provided in the last section.

Objectives of the study

The specific objectives of the study are to:

i. Describe the structure of cocoa market in Nigeria.
ii. Estimate the degree of integration among major domestic cocoa markets in Nigeria.
iii. Evaluate the degree of price transmission between major cocoa exporting/ processing firms and farm gate.
iv. Evaluate the degree of price linkage between cocoa farm gate and border price.

2. Structure of Nigerian cocoa market

This section describes the structure of cocoa market from production to export pricing in Nigeria. Emphasis is laid upon production, pricing, and the framework of the supply chain.

Production and export

In recent years, Nigeria is the fourth largest producer of cocoa, contributing about 7% of the world production in 2009 (Table 1). This is a sharp contrast to the production in 1964 when Nigeria was the second largest producer. The total world production in 1964 was about 1.5 million tonnes, and Nigeria was contributing about 19.77%. In spite of sharp decline in production, cocoa is still the second largest major non-oil foreign exchange earner in Nigeria after leather. It is produced in 16 states of the federation, namely, Ondo, Cross River, Oyo, Osun, Ekiti, Ogun, Edo, Kogi, Akwa Ibom, Delta, Kwara, Abia, Ebonyi, Rivers, Taraba, and Adamawa. The annual production stood at 240,000 tonnes in 2009, and about 98% of the production is exported. It provides means of livelihood, sustenance and employment opportunities to over five million Nigerians, and the export revenue in 2009 is about US$136.7 million. The production is dominated by smallholder farmers, with average farm size of 2 hectares while the export is dominated by Agro Trader Nigeria Ltd., Cocoa Products Nigeria Ltd., and Stanmark Cocoa Company Nigeria Ltd. Major markets destinations for Nigeria cocoa are the Netherlands, U.K, France, Germany, Spain, Italy, USA, and Japan. Other markets being explored are the emerging economic powers of China and India.

Table 1: World production of cocoa beans

	2008		2009	
Country	Thousand tonnes	Per cent	Thousand tonnes	Per cent
Africa	**2687**	**72**	**2484**	**70.7**
Cameroon	185	5	210	6
Cote d'Ivoire	1382	37	1222	34.8
Ghana	729	19.5	662	18.8
Nigeria	220	5.9	240	6.8
Others	171	4.6	150	4.3

America	**453**	**12.1**	**456**	**13**
Brazil	171	4.6	157	4.5
Ecuador	111	3	112	3.2
Others	171	4.6	187	5.3
Asia and Oceania	**591**	**15.8**	**575**	**16.4**
Indonesia	485	13	475	13.5
Papua New Guinea	52	1.4	52	1.5
Others	54	1.4	48	1.4
World Total	**3731**	**100**	**3515**	**100**

Source: ICCO, www.icco.org/statistics/production.aspx

A simplified version of Nigerian domestic cocoa supply chain is as shown in Figure 1. The structure of domestic cocoa market in Nigeria is as shown in Figure 1. The farmers are many (about 30,000) and are the basic starting points. The farmers sell their cocoa beans either directly or indirectly to an exporting/processing firm. The indirect approach is usually via a cooperative and/or a local buyer. The local buyer can either be a broker or a licensed buying agent. The brokers buy dry cocoa beans from farmers at the farm gate and sell to licensed buying agents. Farmers sometimes bring their cocoa together when they belong to cooperative societies. Like licensed buying agents, cooperative societies grade cocoa beans and sell to exporting/processing firms. From the collection centres located in big towns, cocoa beans are transported to exporters' warehouses in Lagos and/or Calabar port area. The warehouses belong to companies formally registered with the government as cocoa exporters for each cropping season. The exporters are either expatriates or local firms. A breakdown of total export data in 2008 and 2009 for the nation is shown in Figure 2. The total export in 2008 was 167,555 metric tonnes. This value declines by about 7.19% in 2009 due to unfavourable climatic condition (Com-Watch, 2009).

At present, about 23 cocoa exporting firms (local and expatriates) are registered with Nigeria Export Promotion Council (NEPC). Appendix A presents 23 of these companies. The selection of those in the appendix was based on current registration status with Nigerian Export Promotion Council, volume of operation, availability of price data and accessibility of location in terms of ease of transportation.

Figure 1: Supply chain of cocoa in Nigeria

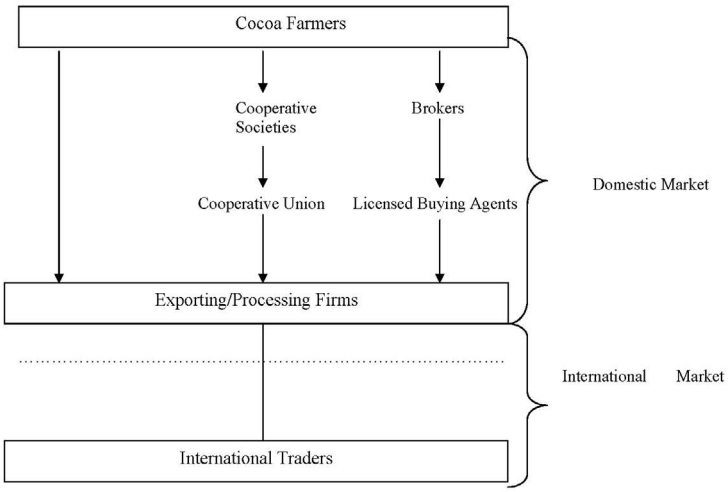
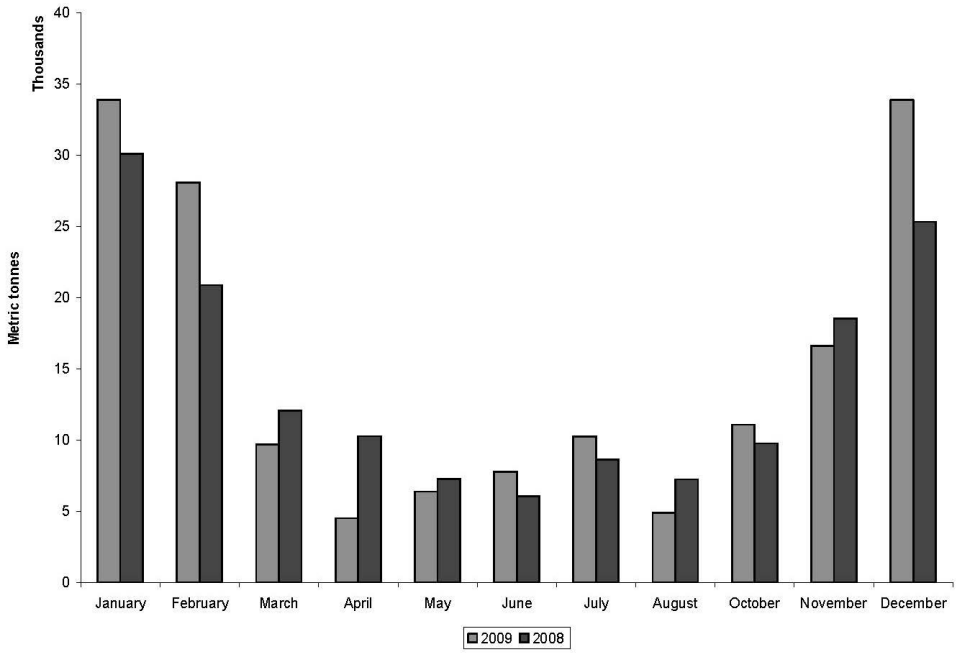


Figure 2: Breakdown of cocoa export data in Nigeria, 2008–2009



Source: Federal produce inspection service department

Despite liberalization, cocoa export market in Nigeria remains dominated by three companies: Agro Trader, Cocoa Products, and Stanmark. In recent time, these

companies accounted for about one-third of all Nigerian cocoa exports (Table 2). All the three dominant companies are better positioned in terms of access to major source market. All of them are located in Ondo State, the largest cocoa producing state in Nigeria. The competitive edge of the major exporters may also be attributed to their business and policy environment that encourage the private traders to support the farmers, fund research, and engage in extension services to raise the productivity and cocoa beans quality of the farmers. Stanmark Nigeria Ltd., for example, organized about 42 cocoa farming communities into viable cooperative societies. The firm holds regular consultative forum with the farmers before any major intervention in terms of input subsidies and cocoa beans quality control. Stanmark Nigeria Ltd. represents the only major direct contact of cocoa farmers with the end-user of cocoa beans.

Access to $15 million loan (largest loan obtained so far by single cocoa exporting/processing firm in Nigeria) boosted Agro Trader Ltd. cocoa beans exports. Through the loan, the firm was able to alleviate credit constraints of many farmers. The farmers got the fund as bonds from the local buyers working for the exporting firm. A major disadvantage of the process is the tendency to reduce the real worth of the farmers' output. Apart from this type of bond, cocoa farmers mobilize funds through their cooperative societies. The interest rate varies from 10% to 15% depending on whether the payment period is one year or eighteen months, respectively. Many farmers, however, cannot access such loans because of poor savings. The competitive edge of Cocoa Products Ltd. over many exporting firms might be due to its ownership structure. Formerly owned completely by Ondo State (leading cocoa producer in Nigeria), 90% of the shares has been acquired by Skye bank under privatization of public-owned enterprises.

In contrast to export supply situation, Nigerian cocoa production is less concentrated, with about 30,000 cocoa farmers accounting for all cocoa beans produced in the country. Many of the cocoa farmers are contracted to exporters they deal with. Some of the exporters, however, have established agents in the cocoa farming localities to take the risk involved in purchasing and dealing with farmers directly. Now that cocoa marketing board has been abolished and few firms dominate exports, if the market post-liberalization were characterized by perfect competition, then margins should vary across space by differences in transaction costs that are determined by infrastructure conditions, distance to port or buying centre, fuel prices, technology, and other costs that are incurred during transport. If private agents, who now interface directly with farmers, have the ability to exert oligopsony or monopsony power, then margins will also contain rents that allow part of the efficiency gains to accrue to the private intermediaries, and these may vary according to institutional relationships.

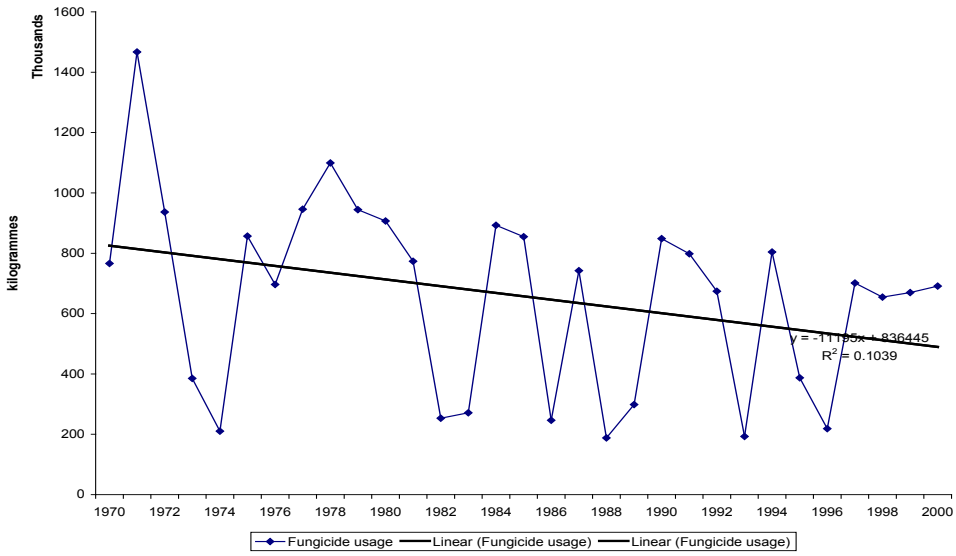
Table 2: Breakdown of Nigerian annual cocoa export in 2009 by exporting firms

Company	Export data	% of total
Agro Trader	20,000	12.80
Stanmark	12,000	7.67
Cocoa Products	15,000	9.60
Others	109,320	69.93
Total	**156,320**	**100.00**

Sources: Company files and Federal Produce Inspection Service Department

At present, the challenges facing the exporting firms can be divided into two broad categories: local and international. The local challenges include unregulated market structure, multiple taxation and levies by federal, state and local governments, as well as unions. Others include high cost of borrowing; inadequate supply of quality input materials; lack of infrastructural facilities, such as electricity, road network, treated water supply, and communication facility. Also, inadequate trade information, poor storage and warehousing facility and price instability due to incessant fluctuation of the price of raw materials, finished product, and local exchange rate are other challenges. The international challenges include Economic Partnership Agreement (EPA) levy; Maximum Residues Level (MRL); use of food grade jute bag; conformance to zero level ochratoxin; and non-child labour in cocoa beans sourcing. The greatest local challenges, however, are associated with availability and affordability of pesticides and high cost of borrowing. Since 1986, Nigerian governments have removed subsidies on purchased inputs and abolished all the intermediary roles of NCB and the Nigerian Produce Marketing Company. Farmers, therefore, rely on forces of demand and supply to determine the prices of pesticides. Figure 3 shows that the use of fungicide (most reliable pesticide used by cocoa farmers to fight phytophtora pod rot – most important limiting factor in Nigeria cocoa industry) has reduced following abolition of NCB. Recently, European Union (EU) legislated on Maximum Residue Levels (MRLs) allowed on cocoa beans and its products. In response, efforts are now being intensified to seek measures towards reduction of fungicide usage. The Cocoa Research Institute of Nigeria (CRIN) has been mandated to screen and recommend potential cocoa fungicides and spraying equipment in Nigeria. With the new EU legislation on MRLs allowed on cocoa beans and products, some of the fungicides still undergoing screening and the previously recommended pesticides were banned. This new regulation, which came into effect on September 1, 2008, has further left very few fungicides for use on cocoa, both on-farm and post-farm activities in Nigeria. The downward trend of fungicide usage following cocoa market liberalization is shown in Figure 3.

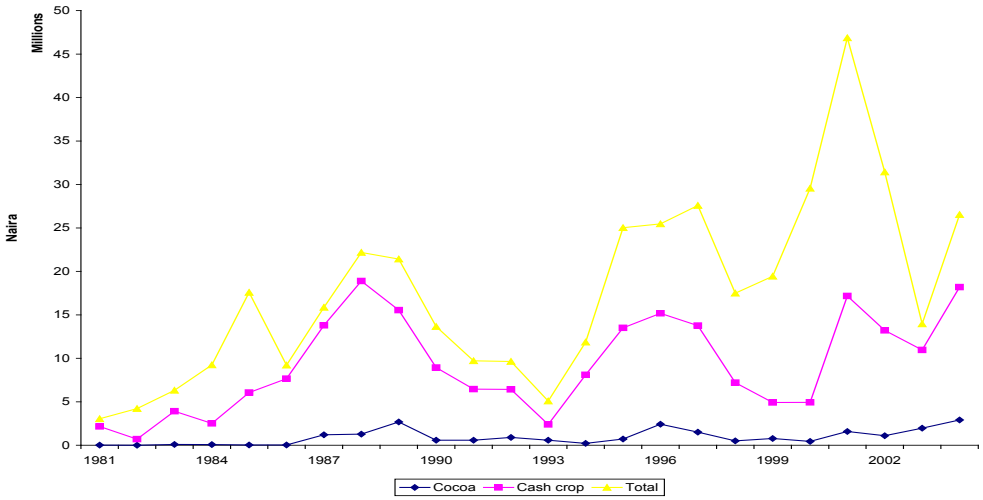
Figure 3: Fungicide usage, 1970-2000



Source: National Bureau of Statistics, Abstracts of Statistics (several issues)

In order to ensure regular supply of high quality cocoa beans, some of the exporting firms are assisting cocoa farmers through supply of agrochemicals, equipment, seedlings, and soft loans. However, an important way for exporting firms in Nigeria to access funds is through government instituted Export Expansion Grant (EEG). The implementation committee consists of Nigeria Export Promotion Council (NEPC), Federal Ministry of Finance (FMF), Nigeria Custom Service (NCS), Central Bank of Nigeria (CBN), Federal Ministry of Commerce, Federal Ministry of Industry, and Special Adviser to the President. The EEG is supposed to pay non-oil exporting firms about 30% of their export value in form of tariff and duty waiver. A problem with the scheme has, however, been irregularity in the payment. The idea of EEG is essential to save exporting firms from failure of formal financial institution to meet their credit need. The low share of the value of loan from Agricultural Credit Guarantee Scheme Fund (ACGSF) to cocoa sector from 1981 to 2007 is shown in Figure 4.

Figure 4: Values of loan allocated to cocoa sector from Agricultural Credit Guarantee Scheme Fund (ACGSF)



Source: Central Bank of Nigeria (CBN) Statistical Bulletin 2007

Following Abbot (2003), in specific terms, the problems facing the exporters as classified in this post-market liberalization era can be summarized into five categories. They include: (1) spatial oligopsony, where few buyers are serving many remote farmers; (2) exporter concentration, where market power among concentrated exporter could lead to large exporter margin; (3) missing market for quality, where lack of discounts for quality are passed back to cocoa farmers; (4) scale economies in assembly, distribution and transportation; and (5) market information. The central focus of this work is to test for possibility of non-competitive behaviour and hence possibility of market power among the major exporters. Since the basic statistical evidence provided in this section may not support possibility of market failure, formal analyses that focus on dynamics of price formation and transmission may be necessary to show external expression of market power. This type of analysis is still lagging behind on Nigerian cocoa sector.

Prices

Within the supply chain, economic agents in Nigeria encounter several types of cocoa prices, namely, farm gate price, individual export price, border price, and the world price.

Farm gate price

These are domestic prices paid directly to the farmers in cash by the brokers or agents dealing directly with them along the supply chain at the point of sales. In this post-liberalization period, it is usually a residual of the f.o.b price after transportation, conditioning, taxes, and other marketing costs such as rents to traders or exporters.

This is contrary to the situation in pre-liberalization period when the farm gate price and marketing margins were mandated and any rents were collected exclusively by the government in the form of taxes. The statistics obtained on these prices depends on the enumeration area of the national bureau of statistics. The price may, therefore, vary from individual state figure because they are calculated as an average price for the major producing regions.

Border price

The reference (border) price is the import (c.i.f.) or export (f.o.b.) price of a commodity used for calculating the market price support price gap, measured at the farm gate level. In this study, the Lagos port prices (average export prices collated by the federal inspection service departments) are used as the border price for the nation while the national farm gate refers to the average farm gate prices of the producing states. The accuracy depends on the enumeration area covered by the National Bureau of Statistics when collecting the data.

Individual export prices

These are discounted world prices set by an exporter as a function of cocoa future prices on international markets. Once in the hands of the exporter, the cocoa product is shipped to processors who pay the c.i.f price represented by the International Cocoa Organization (ICCO) price. In this study, individual export price is computed as the average export price achieved by an exporter for all markets served by his firm at a particular period of time.

World price

The world price (ICCO) depends on trading in futures for cocoa beans. Cocoa futures contracts are mainly traded on London Financial Futures Exchange (LFFE) as well as New York Board of Trade (NYBOT). Each agent along cocoa supply chain receives a share of the world price. Nigerian cocoa is usually exported at a discount from the world price due to quality difference. After exporters pay all fiscal and quasi-fiscal levies, the margin between the export price and the farm gate is split between the exporters and the local intermediaries.

3. Literature review

3.1 Theoretical literature review

A comprehensive review of models used in spatial price analysis can be found in Fackler and Goodwin (2001). Generally, empirical tests of the performance of spatially separated markets are conducted within the framework of spatial price equilibrium (SPE) theory developed by Enke (1951), Samuelson (1964), and Takayama and Judge (1971). The central focus of this theory is that, price relationships between spatially separated competitive markets largely depend on the size of transfer costs. In particular, in spatially efficient markets, the price difference between regions engaged in trade should be less than or equal to transfer costs.

Given two markets located in different regions (i and j) that may engage in trade for a given homogenous commodity, Negassa and Meyer (2007) identified three mutually exclusive and exhaustive spatial arbitrage conditions, or trade regimes could be identified based on the relative sizes of contemporaneous spatial price differentials and transfer costs. Assuming Pit to be the commodity price in region A, Pjt the price in region B and TC the transfer cost, in regime one, trade may or may not be occurring if the spatial price differential is equal to transfer cost:

$$Pit - Pjt = TC$$

In this regime, the traders are not making excessive or economic profits from regional trade, due to competitive pressure in the marketing system. With trade between the markets, the price movements in different markets are related due to changes in either market supply and demand conditions or the stochastic disturbance terms. In regime two, the spatial price differential is less than transfer cost and is given as:

$$Pit - Pjt < TC$$

This regime represents a market condition where no profitable arbitrage opportunities exist between the two markets. If there is trade between the markets, it is inefficient because traders are making losses. This indicates that efficient allocation does not necessarily require physical trade flows between markets. The prices in the two regions are independent due to very high transfer costs, and shocks are not transmitted across the markets.

Finally, regime three is given as a condition where trade may or may not be occurring if the spatial price differential is greater than the transfer cost:

$$Pit - Pjt > TC$$

In this regime, the spatial arbitrage condition is violated and the markets are not efficient, but may be integrated to some extent if some trade is occurring. In this regime, there are opportunities for profitable spatial arbitrage that are not being exploited. If the markets are efficient, competition is expected to equalize the spatial price differentials and transfer costs, and the transfer costs are the largest price difference that can exist between two markets engaged in trade. It is argued that, violation of the spatial arbitrage condition is an indication of the existence of impediments to trade between markets and should be considered as evidence supporting the lack of perfect market integration (Baulch, 1997). Among several conditions that may lead to regime three is the existence of transportation bottlenecks, non-competitive pricing practices, government controls on product flows between regions, government price support activities, licensing requirements, and quotas (Tomek and Robinson, 1990; Baulch, 1997).

Early empirical studies of market integration used static price correlations to test for spatial market integration in agricultural markets (Jones, 1968; 1972; Farruk, 1970; and Lele, 1972). This kind of modelling of spatial market integration has been criticized for masking other effects like inflation and seasonality. In order to overcome the weaknesses of price correlation tests, various alternative methods have been developed (Delgado, 1986; Ravallion, 1986; Engle and Granger, 1987; Johansen, 1988).

Empirical literature review

The availability of some basic statistical evidence in support of the feasibility of the market power story is not sufficient to make any valid statement on the existence of market power. Researchers have relied on formal analyses that focus on the dynamics of price formation and transmission to establish plausibility of market power. At present, this type of research is still at low ebb in Nigeria. Though, several works have been done in sub-Saharan Africa (SSA) and other developing nations (Abdulai, 2000 for Ghana; Rashid, 2004 for Uganda; Kuiper et al., 2003 for Benin; Meyers, 2008 for Malawi; Negassa and Meyers, 2007 for Ethiopia; van Campenhout, 2007 for Tanzania; Moser et al., 2009 for Madagascar), the works focus on staple crops. Quite a few works have been done on tree crops' market integration (Fold, 2002; Losch, 2002; Wilcot and Abbot, 2004; Sheperd, 2004; Gilbert, 2006; Panlibuton and Lusby, 2006). Fold (2002), Losch (2002), Wilcox and Abbot (2004) provide insight into how the market structure of west African cocoa has changed, and may further change, due to liberalization. The authors provide anecdotal evidence supporting the possibility that liberalization resulted in backward integration by the multinational grinders and subsequent market power exertion.

Gilbert (2006) examines the potential contribution of global value chain analysis in the commodity sector. Substantively, he aims to provide explanation for dramatic falls in the producers' share of the retail prices of cocoa and coffee products. His results fail to provide any evidence supportive of high levels of processors' concentration. Rather, he attributes decline in producer value shares to evolution of cost structures in the processing industries. Panlibuton and Lusby (2006) investigate cocoa value chain in Indonesia. They examine the incentives, and risk, that various market actors in the Indonesian cocoa value chain have for investing in improved consistency in cocoa beans quality and how the actors are responding to the incentives. They found out that

the overall structure of the cocoa value chain in Indonesia continues to be rationally driven by volume and price based transactions. They also show that, unless market signals from multinational buyers of cocoa beans change, there is limited scope for a development programme to facilitate greater adoption of upgrading by smallholder farmers.

Sheperd (2004) used vector autoregressions to model price transmission through coffee processing chain from producers to the world market and from world market to consumers. He made a comparison of liberalization between pre-1989 and post-1989 market structures. The results show that, liberalization has not improved price transmission as significantly as expected and, in some respects, appear to have worsened it noticeably. The problem was attributable to market power of the private actors at the intermediate levels in the coffee processing chain.

Krivonos (2006) evaluates the impact of coffee sector reforms during late 1980s and early 1990s on coffee growers in the main coffee producing countries. Using cointegration and error correction model, he tested the evidence that the reforms increased the share of producer prices in the world price of coffee. The results show that in most countries the long-term producer price share has indeed increased substantially after the liberalization. Moreover, the results suggest that the reforms induced a closer cointegrating relationship between grower prices and world market prices. Finally, estimation of an error correction model reveals that short-run transmission of price signals from the world market to domestic producers has improved, such that domestic prices adjust faster today to world price fluctuations than they did prior to the reforms. Goshray (2009) examines price relationships of different qualities of coffee and how prices adjust over time in relation to each other. The main result shows that using threshold models, the coffee market may be considered to be highly integrated. Further, the results indicate that either prices adjust to any deviation only when they are increasing or decreasing, or that a rise in the price of a high quality coffee might lead to a slower rise in the price of a relatively lower quality coffee, while a decline in higher quality coffee prices might trigger a relatively rapid fall in lower quality coffee. Onya and Ajutu (2006) investigate the extent to which changes in the international prices of commodities exported by Uganda are transmitted to the domestic producer prices. They also investigate the factors affecting price transmission to domestic producer prices. Producer prices were regressed on international prices in various forms, taking into account the possible effects of inflation by expressing both the international and the producer prices in terms of the United States dollar. The empirical analysis was based on data collected from various sources for the period January 1991 to March 2006. The results of the analysis show that the extent to which the international prices of the agricultural commodities exported by Uganda are transmitted to the domestic producers varies from commodity to commodity. Cocoa and coffee reveal a significant transmission of the international price to the producer prices. On the other hand, cotton, tea, tobacco, and maize indicate no significant transmission of their international prices to the domestic producer prices.

Many researchers have also analysed market power using price transmission in vertically integrated supply chains for other commodities in other parts of the world (Chavas and Mehta (2002); Guillotreau et al., 2003; Zachariasse and Bunte, 2003; Sheperd, 2004; Muldoon and Johnston, 2006). Chavas and Mehta (2002) developed

a reduced-form model of price transmission in a vertical sector, allowing for refined asymmetric, contemporaneous and lagged, own and cross price effects. They used the model to analyse wholesale-retail price dynamics in the US butter market. The analysis provided strong evidence of asymmetric price transmissions and showed the complex nature of nonlinear price dynamics in a vertical sector and its implications for the distribution of future prices. Muldoon and Johnston (2006) explored market chain issues for the live reef food fish trade in the Asia-Pacific region. They found out that, with supply dominated by artisanal fishers in developing countries, there are concerns that gains are being unevenly distributed along the chain. Moss and Guerra Galindo (2001) investigated market power amongst Mexican processors. In a standard regression of the world-producer price spread, neither processor concentration nor total exports were statistically significant. The authors conclude that the evidence did not indicate either market power amongst processors or Mexico's having the ability to affect world market prices.

Cramon-Taubadel and Goetz (2007) analysed whether market power was exerted by exporting companies over Israeli citrus growers in the form of asymmetric price transmission. The study investigates vertical price transmission across international borders, i.e., in the context of Israeli grapefruit exports to France. They explicitly account for possible changes in exporters' pricing behaviour in the post-liberalization period. The researchers apply an error correction model (ECM) to disaggregated firm-level Israeli grower price and French import price data. In the study, an ECM is estimated individually for each of the major exporting companies within a seemingly unrelated regression (SUR) framework. The results show asymmetric price transmission in the first years after liberalization, but symmetry in the second half of the 1990s. The growers' losses due to asymmetry amounted to as much as 2.5% of their total revenues. The results suggest that liberalization improved the efficiency of the Israeli citrus international marketing channel, but that this took time and was probably accelerated by government intervention.

Alam et al. (2010) examines the price transmission between the wholesale and retail level of the rice market in Bangladesh in the context of the changing market environment. They also examine whether the wholesale market dominates the retail one, and whether the price relationship is symmetric with respect to price increases and price decreases. In the paper, the authors use the average wholesale and retail price of rice for Bangladesh collected from FAO and different published series of *Statistical Yearbook* and the *Economic Trend*. The data period cover from February 2002 to June 2007. The results show that the wholesale and retail prices are integrated, and in the line of the industrial organization theory, the wholesale price plays a leadership role to determine the retail prices. Results also confirm that the consumer and public concern about the asymmetric price transmission holds true. Zhang et al. (2009) describes how governance mechanisms were formed that link small-scale apple farmers in China with export markets. The authors indicate that, institutional innovations have improved the efficiency of price transmission and generated higher profit margins for various actors in the Chinese apple supply chain, in particular for small-scale farmers. Their report shows that Chinese apple exports are highly coordinated through ongoing long-term loyal network relationships and vertical integration.

Saha and Mitura (2008) investigate the dynamics of price transmission between the Canadian beef markets along the supply chain and the impact of bovine spongiform encephalopathy (BSE) on prices. Retail price models are estimated for the provinces accounting for the major share of national demand, while farm price models are estimated for the beef cattle producing provinces. A model for the processing level is also estimated, with national industrial prices of beef and provincial farm prices of beef cattle. The results indicate that, retail beef prices in the major consuming provinces adjust either faster or at a greater magnitude to increases in industrial prices than to decreases. Furthermore, industrial prices adjust faster and at a greater magnitude in response to rising farm prices of beef cattle in Ontario and Quebec than when they fall. The impact of BSE on retail prices has been small and negative for Alberta and Ontario, and positive for Quebec and British Columbia. The impact of BSE on industrial prices has also been small and positive. On the contrary, strong and sustained negative influence of BSE on farm prices is evident in the results for the beef cattle producing provinces.

Empirically, test of market integration using dynamics of price transmission has not been a topic of extensive research in Nigeria. However, in Nigeria, few exceptions are Delgado (1986), Okoh, (2005), and Oguntade and Folayan (2006). Delgado (1986), using 18 months of weekly grain prices for 22 villages in northern Nigeria, discovered a case of market fragmentation in the study area. On the other hand, Okoh (2005) established that, rural and urban foodstuffs markets in Nigeria are pair-wise cointegrated. Only Oguntade and Folayan (2006) have examined integration in Nigerian cocoa markets. Using annual data from 1986 to 2003, they employed cointegration technique to assess the efficiency of price transmission between central market in Lagos and two source markets (Ondo and Ekiti State) for cocoa beans. They found out that, deregulation policy has increased cocoa market efficiency in the nation. Limitations of the study include: (i) the analysis was restricted to spatial level analysis, and (ii) they did not control for small sample biasness. This study differs from those studies in Nigeria in three ways. First, vertical integration of cocoa markets is analysed. Second, monthly price series from January 2000 to December 2009 are used. Third, the analysis covers post-market liberalization period to draw a conclusion as to whether integration has improved with the abolition of monopolistic marketing channels in Nigeria. An examination of the market functioning at the vertical level in Nigerian cocoa sector is of importance within the period to evaluate how the nature of cocoa market have been affected by private traders who have now replaced the monopsonistic marketing boards.

4. Methodology

Analytical framework

In line with normal practice, as shown in the literature reviewed (Cramon-Taubadel and Goetz, 2007), the empirical analysis is couched in a vector autoregressive framework to test for the existence of stationarity and cointegration between the variables (specifically, prices at the border and farm levels). Thus, given a VAR(p) model:

$$p_t = \alpha_1 p_{t-1} + \alpha_2 p_{t-2} + ... + \alpha_p p_{t-p} + \psi w_t + \varepsilon_t \quad (1)$$

where pt is a (m x 1) vector (1,2,…i, j, ….,m) of jointly determined I(1) variables, wt is a (q x 1) vector of deterministic or exogenous variables and each αi (i = 1,…,p) and ψ are (m x m) and (m x q) matrices of coefficients to be estimated using a (t = 1,….,T) sample of data. εt is a (m x 1) vector of n.i.d. disturbances with zero mean and non-diagonal covariance matrix, Σ.

The first step in such cointegration analysis is to test all the time series variables for stationarity. To achieve this, augmented Dickey-Fuller (ADF) was performed to test whether the data are difference stationary or trend stationary (Dickey and Fuller, 1979). The ADF tests can be expressed as in the following equation:

$$\Delta p_t = c + \rho p_{t-1} + \beta_t + \sum_{j=1}^{k} d_j \Delta p_{t-j} + \varepsilon_t \quad (2)$$

where p_t is the respective price series and Δ the first difference $(p_t - p_{t-1})$ operator and ε_t d notes white noise error term. Equation 1 tests the null of a unit root, $(\rho > 0)$ against a stationary alternative $(\rho < 0)$. Once the price series are found to be non-stationary at levels but stationary at first difference, a test of cointegration is carried out using Engle and Granger (1987) and Johansen and Juselius (1990; 1992) maximum likelihood estimation technique. Once cointegration is confirmed, the equation was estimated to obtain a long-run equilibrium relationship between the data series p_{it} and p_{jt}. It was estimated as a bi-variate relationship for each market pairs. Thus,

$$p_{it} = \theta_o + \theta_1 p_j + \mu_t \quad (3)$$

where $t = 1$…….T, *pi* and *pj* are the two spatially or vertically differentiated prices, for example, farm gate and border prices, respectively. θ_0 and θ_1 are the estimated coefficients. Figures 7, 8, and 10 show that between 2000 and 2002, there exists high degree of integration between farm gate price and the export prices of Agro Trader, Stanmark, and other exporting firms. This is taken into consideration by using dummy variable to cover the period in the cointegration equation. Thus,

$$p_{it} = \lambda_o + \lambda_1 p_j + \lambda_2 D_1 + \lambda_3 D_2 + \lambda_4 D_3 + \mu_t \tag{4}$$

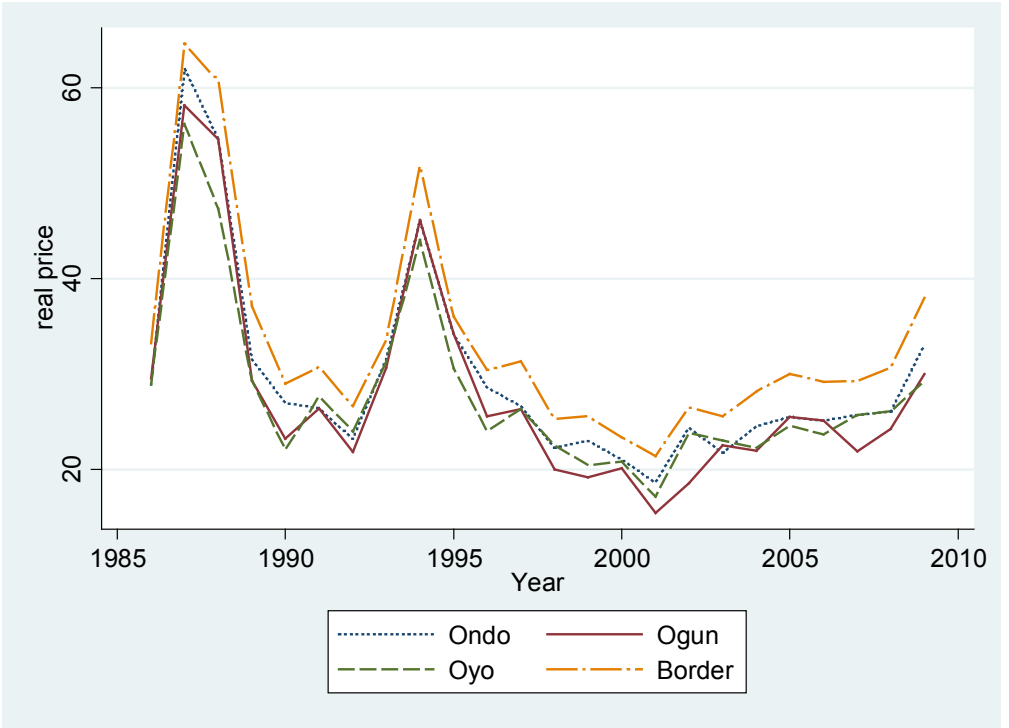
where, D1, D2 and D3 are, respectively, dummy variables for year 2000, 2001, and 2002. *pi* and *pj* are national farm gate and exporting firms' prices, respectively. $\lambda_0 - \lambda_4$ are the coefficients. Provided there is at least one cointegrating relationship between the variables in the system, the residual vector μ_t which represents the short-run deviations from the long-run equilibrium is lagged by one period and enters the ECM as the error correction term. The ECM model is represented by the following equation:

$$\Delta \mathrm{P}it = \alpha 0 + \sum \alpha 1i\, \Delta \mathrm{P}it\text{-}1 + \sum \alpha 2i \Delta \mathrm{P}jt\text{-}1 + \varphi ECTit\text{-}1 + uit \quad (i=1\ldots n1) \quad (j=1\ldots n2) \tag{5}$$

Overview of the dataset

The analyses are based on the following secondary data: (i) monthly firm-level price data from nine major Nigerian cocoa beans exporting firms separated into three largest and others, (ii) 1986-2009 annual price data from three major cocoa producing states, namely, Ondo, Ogun and Oyo states, (iii) monthly and aggregate border price in Lagos port, and (iv) monthly world price. The firms' monthly data cover 2000-2009, while the states' annual data cover 1986-2009. All the data series are expressed in Nigerian Naira per metric ton and deflated with the Nigerian monthly or aggregate consumer price index (1985=100) as the case may be. The farm gate prices of three major cocoa producing states in Nigeria, namely, Ondo, Ogun and Oyo state are shown in Figure 5. The three major firms selected are mainly sourcing for their raw materials from these states. The magnitude at which price signals between the states' cocoa markets are transmitted will provide insight into their degree of market integration so as to be able to make inferences about the capability of spatial arbitrage to soften the price.

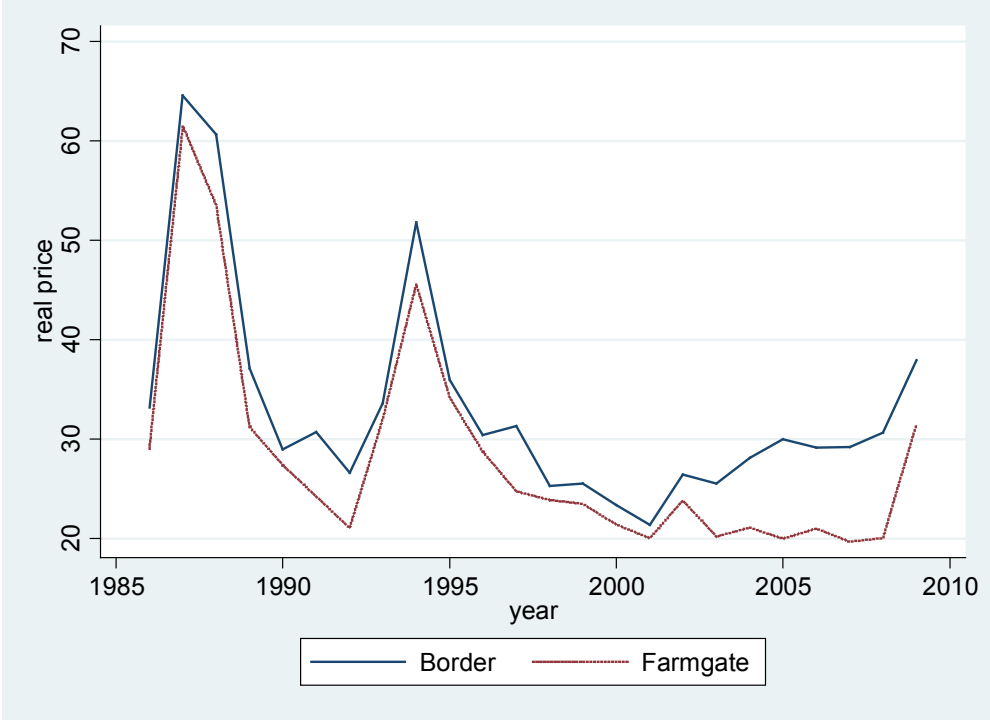
Figure 5: Producing states' farm gate prices versus border price



Source: Ministry of Agriculture Cocoa Development Unit, NBS Abstract of Statistics

Figure 5 shows that there is no evidence of market segmentation among the producing states. This suggests that the markets exhibit high level of efficiency, a condition for profitable arbitrage and linking of markets. A simple implication is that, since cocoa plantation are located mostly in the states, incomes of the farmers can be enhanced given increase in price incentives for them to intensify their production. The efficiency might have been sustained over times through massive improvement in road maintenance and construction by all the three tiers of governments in southwestern Nigeria, particularly during the civilian regime which has been in place since May 29, 1999. For example, two major expressways pass through Ogun State from Lagos to the northern and eastern parts of the Country, namely, the Lagos-Ibadan and Sagamu-Benin Expressways, while the third one, from Sango-Ota to Abeokuta, is under construction. Another trunk 'A' road links Ogun State to Oyo State. There is also the Ota-ldi-Iroko Road, the Sagamu Interchange, and Ilaro-Ohunbe Road, which leads to the rest of west African countries. Within the last decade, the Ondo State Government has built 105 kilometres of roads. The total cost of construction amounted to 141,277,730 USD. The road network coupled with improved communication network might have been responsible for integration of the state's cocoa market with those of the neighbouring states. The evolution of the co-movement between the national border price and farm gate between 1986 and 2009 is presented in Figure 6. The figure indicates integration of the markets. The divergence observed after 2002 might be because of quality issues the exporters faced which promote sales on spot basis instead of futures contract.

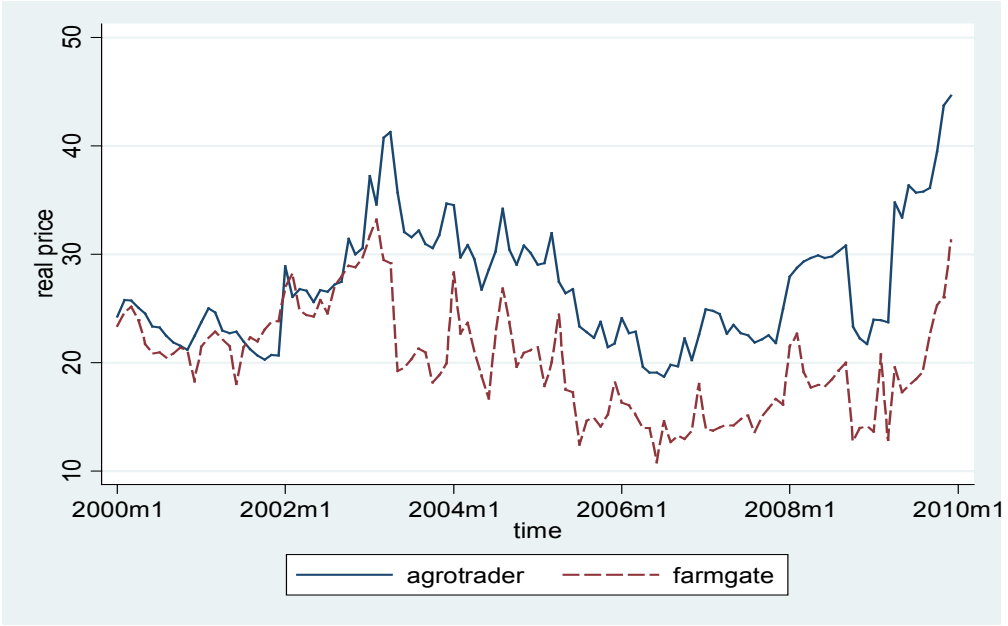
Figure 6: National border price versus farm gate prices



Source: NBS Abstract of Statistics, National Produce Inspection Agency

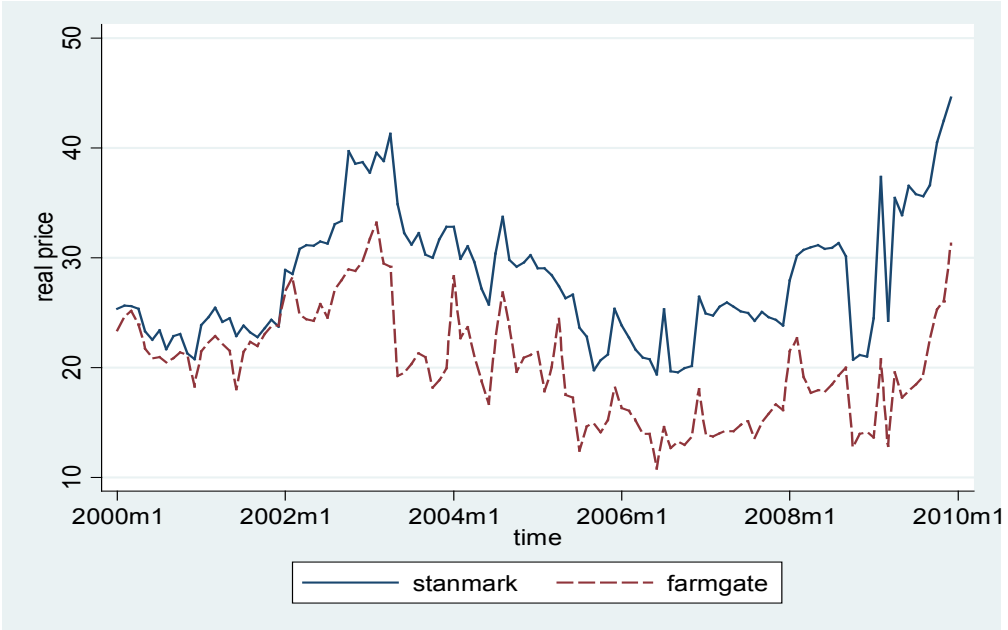
The data showing the evolution of the monthly real prices for the largest exporting firms, namely, Agro Trader, Stanmark, and Cocoa Products, compared to the monthly farm gate price series, are shown in figures 7 to 9. The monthly farm gate prices are obtained by taking the average across producing states' farm gate prices. A weighted average would have been better, but the shares of cocoa beans sourced from different location are lacking. Between 2000 and 2002, there exists high degree of integration between farm gate price and the export prices of Agro Trader and Stanmark. This is taken into consideration by using dummy variable to cover the period in the cointegration equation. It is likely the pricing behaviour of the major cocoa exporters changed from late 2002 to 2003 as the divergence between the prices increases from that period. The volatility might be due to exchange rate shocks and rising costs of transportation, marketing, and transactions. Furthermore, the exporters might have adjusted their long-run pricing approach following difficulties to finance their operation and the need to meet high quality requirements for world market, given increasing competition between Nigeria cocoa exports and those of Ghana and Cote d'Ivoire.

Figure 7: Agro Trader versus farm gate price series



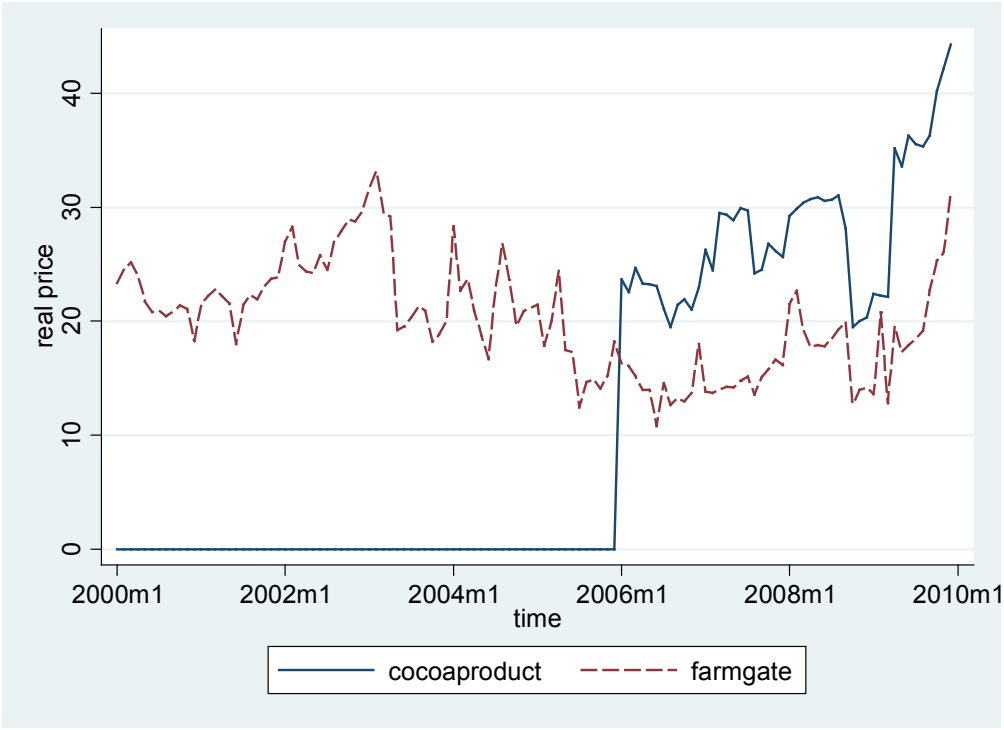
Source: Agrotrader Data Sheets and Newsletters, Agricultural Development Programme Bulletins

Figure 8: Stanmark versus farm gate price series



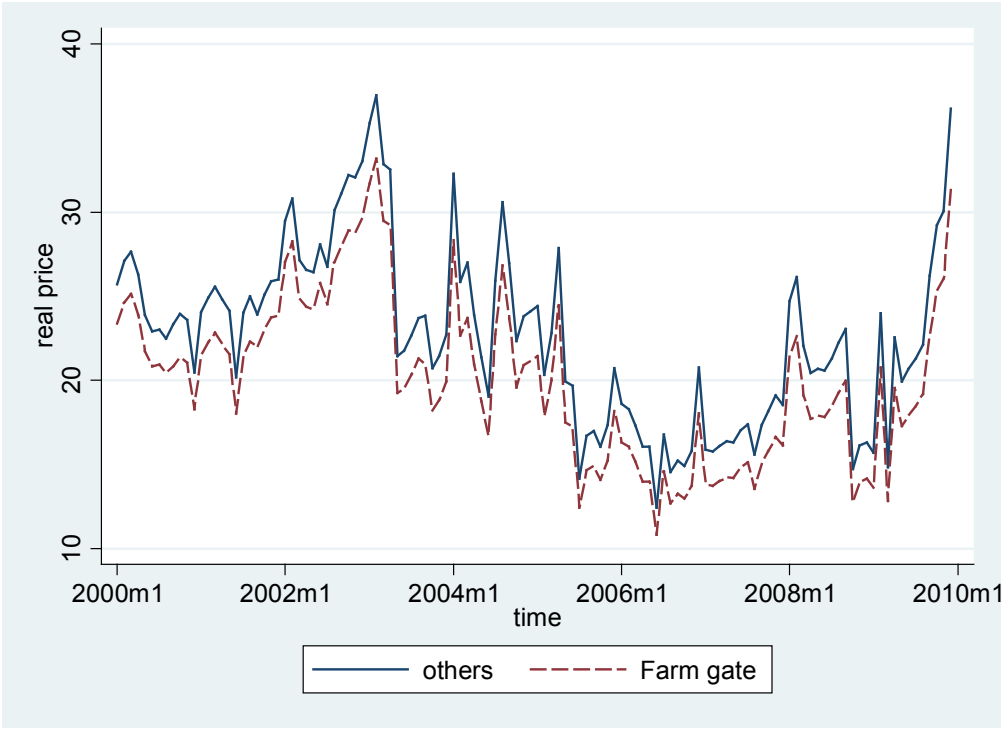
Source: Stanmark Data Sheets and Newsletters, Agricultural Development Programme Bulletins

Figure 9: Cocoa Products versus farm gate price series



Source: Cocoa Product Data Sheets and Newsletters, Agricultural Programme Bulletins

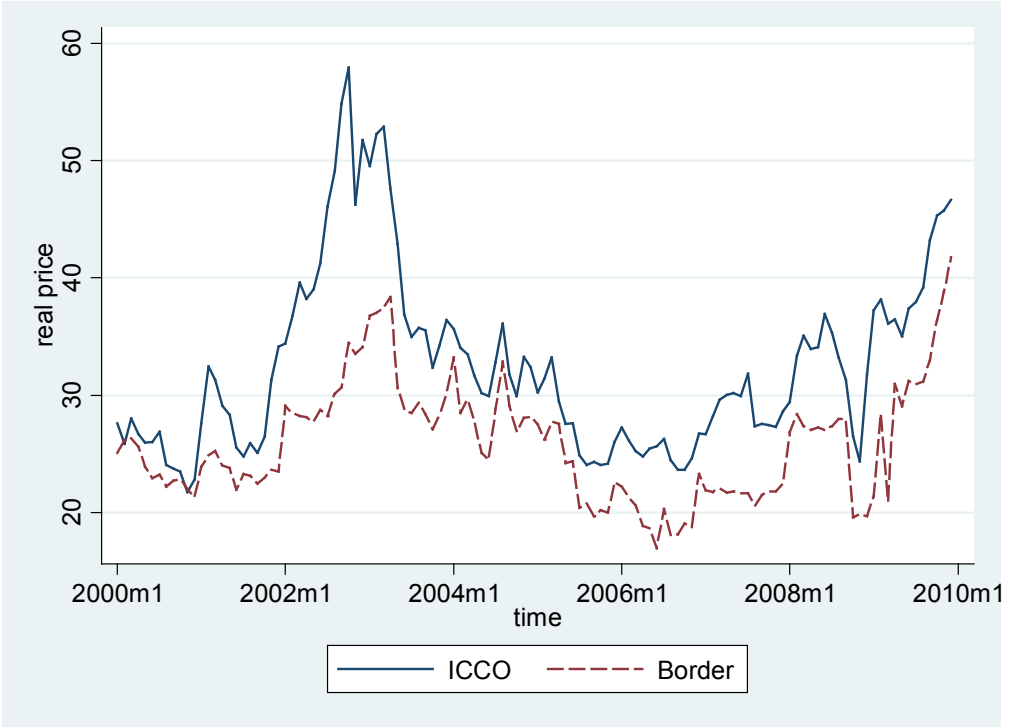
Figure 10: Other firms versus farm gate price series



Source: Each Firm's Data Sheets and Newsletters, Agricultural Developement Programme Bulletins

A picture of price movement between the world price and the producer price between January 2000 and December 2009 is shown in Figure 11. Overall, the figure suggests possibility of efficient transmission of world price to the domestic cocoa market.

Figure11: Annual real world versus producer prices of Nigerian cocoa beans (1985 = 100), 1961-2009



Source: ICCO Database, National Produce Inspection Agency

The graphical illustration of spatial and vertical integration, shown above, tends to indicate that, the only area where integration may be questionable is the link between individual exporting firms' prices and the farm gate. This is the main focus of the empirical analysis which follows a brief review of some methodological literatures. Nevertheless, other markets are taken into consideration since descriptive analysis may not be sufficient to draw valid statements. In order to avoid running a spurious regression, unit root tests were carried out for all the price variables at both state and firm levels. This is followed by Johansen cointegration and Granger tests to discover market pairs exhibiting long-run relationship and the direction of causality.

5. Empirical results and discussion

Most of the regression results that will be reported in this section are intended to supplement the impression already gained by visual inspection of the data series discussed earlier on.

The unit root test

Table 3 presents the summary of the unit root test statistics, in respect of the exporting firms. The ADF test was first performed by including up to 12 lagged terms of the difference terms in the regression in respect of the exporting firms' prices. Akaike information criteria (AIC) was used to select the appropriate lag length, that is equation that has the lowest AIC . The ADF results were derived from a regression analysis which maximized the AIC. Though a visual inspection of the datasets shows seasonal variation in each variable, there is no persistence change in the pattern over time. In response, seasonal dummies are incorporated in the ADF stationarity test modelling. Following Harris (1992) and Harris and Judge (1998), the unit root test for the national and states' annual prices are based on bootstrapping the ADF test because the samples are small. Economists have, however, found out that the ability to detect cointegration depends more on the total sample size than the frequency of the data (Hooker, 1993; Lahiri and Mamingi, 1995; Otero and Smith, 2000).

The results show insufficient evidence to reject the null hypothesis of non-stationarity for all annual price series. The test, however, rejects the hypothesis when applied to the differenced series for all of them. This implies that all the cocoa price series in post-liberalized era are integrated of order one - I(1). In the case of monthly price series, the null hypothesis (presence of unit root) is also rejected for all of them. Given that integrated markets are those whose series show a unit root and become stationary after differencing (d) times, the results indicate that the following market pairs can further be tested for cointegration, given the focus of the study. The price pairs are: Ondo–border, Ogun–border, Oyo–border, Ondo–Oyo, Ondo–Ogun, Oyo–Ogun, Agro Trader–farm gate, Stanmark–farm gate, Cocoa Products–farm gate, other firms–farm gate, border–farm gate, and world–border.

Table 3: Unit root test statistics for annual cocoa market prices

Variable	Regression Equation	Lag	t-ADF Levels	Lag	t-ADF 1st Difference	Order of Integration
Monthly data						
Stanmark	I, SD, Tr	0	-1.890	0	-14.813***	I(1)
Stanmark	I, Tr	1	-1.235	0	-16.081***	I(1)
Cocoa Products	I, SD, Tr	0	-1.628	0	-10.857***	I(1)
Cocoa product	I, Tr	0	-1.644	1	-7.007***	I(1)
Agro Trader	I, SD, Tr	0	-0.937	0	-11.133***	I(1)
Agro Trader	I, Tr	0	-1.532	0	-11.821***	I(1)
Others	I, SD, Tr	4	-1.270	0	-9.215***	I(1)
Others	I, Tr	4	-2.287	3	-9.705***	I(1)
Border	I, SD, Tr	2	-0.874	2	-5,610***	I(1)
Border	I, Tr	2	-1.228	3	-6.097***	I(1)
ICCO	I, SD, Tr	2	-1.472	1	-7.196***	I(1)
ICCO	I, Tr	1	-1.891	1	-9.383***	I(1)
Farm gate	I, SD, Tr	0	-2.368	0	-14.218***	I(1)
Farm gate	I, Tr	1	-1.920	0	-13.806***	I(1)
Annual data						
Farm gate (annual)	Bootstrapping I, Tr	0	-2.254	0	-3.401**	I(1)
Ondo	Bootsrapping, I, Tr	0	-1.683	0	-3.561***	I(1)
Ogun	Bootsrapping, I, Tr	4	-0.497	3	-5.330***	I(1)
Oyo	Bootsrapping, I, Tr	0	-1.638	0	-3.669***	I(1)

I = constant; Tr = trend; SD = seasonal dummies; MacKinnon (1996) critical values: 1% = -3.487, 5% = -2.886, 10% = -2.580; *** denotes significant at 1% level; ** significant at 5%; and * significant at 10%.

Market integration tests at state levels

Vertical integration of the farm gate price series from Ondo, Ogun, and Oyo states are tested with both Johansen's lambda-max (LM) and trace tests and Engle and Granger procedure. The results are presented in Table 4. Given the three source markets, three pair-wise relationships are considered, where each state price series is paired with the border price. The empirical results clearly indicate the presence of at least one cointegrating vector in each market pair at the 5% level. This implies that

cocoa trading in Nigeria are vertically integrated. The vertical integration is revealed by high vertical price linkage between each state price series and the border price series. When compared with Delgado (1986) results, market liberalization could be said to have considerably improved market integration vertically in Nigerian cocoa farm gate markets. In the post-liberalization dispensation, the exporters are competing for the cocoa beans produced by farmers at the state levels. Therefore, the cocoa farmers have more opportunity to command higher prices.

Table 4: Market integration tests at state levels

Price pair	Null hypo-thesis	Alternative hypo-thesis	Trace test	Critical value	Max. Eigenvalue	Critical value	ADF/ EG	Critica value
Ondo, Border	r = 0 r = 1	r = 1 r = 2	31.085** 9.188**	15.495 3.841	21.897* 9.188**	14.265 3.841	-5.594**	-2.991
Ogun, Border	r = 0 r = 1	r = 1 r = 2	22.820* 6.189**	15.495 3.841	16.631* 6.189**	14.265 3.841	-4.571**	-2.991
Oyo, Border	r = 0 r = 1	r = 1 r = 2	29.700** 11.404***	15.495 3.841	18.296* 11.404*****	14.265 3.841	-4.027**	-2.991

*** denotes significant at 1% level, ** significant at 5%, and * significant at 10%.; r is the number of independent cointegrating vectors.

The long-run relationships between the cointegrated pairs are presented in Table 5. The results are based on Engle and Granger methodology since the unit root tests for the regression residuals suggests that the long-run relationships hold for all the market pairs (Table 3). As expected from economic point of view, there exists positive relationship between each state farm gate and border price series. The relationship between Oyo farm gate and border price series is somehow weaker than those of Ondo and Ogun. This might be due to transport cost occasioned by poor road network and long distance between cocoa farms in Oyo State and trunk 'A' road which connects Oyo State to Lagos. On a general note, however, the introduction of market liberalization could be said to be delivering on its promise of "good prices" for cocoa beans.

Table 5: Long-run relationship between state level prices

Market pair	Exogenous	Constant	Coefficient	AdjR2	F	DW
Ondo, Border	Border	-2.052** (0.814)	0.954*** (0.023)	0.986	1673.944	2.345
Ogun, Border	Border	-4.389*** (1.110)	0.972*** (0.032)	0.976	933.996	1.911
Oyo, Border	Border	0.837 (1.137)	0.815*** (0.033)	0.965	625.245	1.744

**** denotes significant at 1% level, ** significant at 5%, and * significant at 10%. The DW statistics is compared with the critical value in Pindyck and Rubinfield (1996).

DUL = 1.635 and DWU = 1.679. In parentheses are standard errors.

Market integration tests at firm–farm level

The degree of vertical integration between each of the exporting firm's price series and the farm gate price series are tested with multivariate Johansen's lambda-max (LM) and trace tests. The relevant model tested is Equation 4 for Agro Trader–farm gate, Stanmark–farm gate, and farm gate–others market pairs. The test results are presented in Table 6.

Table 6: Cointegration test statistics for firm–farm relations

Price pair	Null hypothesis	Trace test	Critical value	Max. Eigenvalue	Critical value
Farm gate-Agro Trader	r = 0	70.765**	69.819	24.407	33.877
	r = 1	46.357	47.856	16.864	27.584
	r = 2	29.463	29.797	14.219	21.132
	r = 3	15.244	15.495	12.026	14.265
	r = 4	3.218	3.841	3.218	3.841
Stanmark-farm gate	r = 0	69.241	69.819	25.550	33.877
	r = 1	45.276	47.856	19.830	27.584
	r = 2	28.515	29.797	15.308	21.132
	r = 3	16.053*	15.495	13.650	14.265
	r = 4	4.419*	3.841	9.953**	3.841
Farm gate-Cocoa Products	r = 0	7.547	15.495	4.759	14.265
	r = 1	2.788	3.841	2.788	3.841
Farm gate-others	r = 0	92.894**	69.819	33.420	33.877
	r = 1	59.474**	47.856	25.265	27.584
	r = 2	34.209**	29.797	17.943	21.132
	r = 3	16.266	15.495	12.887	14.265
	r = 4	3.379	3.841	3.379	3.841
Farm gate-Border	r = 0	70.405*	69.819	24.773	33.877
	r = 1	45.632	47.856	17.199	27.584
	r = 2	28.432	29.797	12.818	21.132
	r = 3	15.614*	15.495	11.828	14.265
	r = 4	3.786	3.841	3.786	3.841

*** denotes significant at 1% level, ** significant at 5%, and * significant at 10%.

The model includes dummies to take cognizance of year 2000, 2001, and 2002 when high integration were found in the relationship between export price series of all the firms and farm gate price series except Cocoa Products. For the integration between Cocoa Products and farm gate price series, Equation 3 is tested. At 5% level of significance, the likelihood ratio (LR) test based on the trace of the stochastic matrix indicates presence of at least one, two, and four cointegrating vectors for Agro Trader, Stanmark, and other firms, respectively. The cointegrating test fails in the case of Cocoa

Products.

In the absence of any additional restrictions, the cointegrating relationships are merely statistical rather than economic. By imposing one normalization restriction, farm gate price series exactly identifies the system. The implication is that farm gate and the export price series are pair-wise cointegrated, except for Cocoa Products. This might be because data for 2000-2005 are not available. In analysing the cointegrating coefficients, the cointegrating vector is normalized with respect to the farm gate price series. The normalized cointegrating equations for the firms are presented in Table 7. The OLS test for cointegration between the farm gate price series and Cocoa Products price series is also shown in the table. Integration of Cocoa Products–farm gate price series is tested with OLS because the pair does not support Johansen's tests for cointegration. Though the results clearly show a case of market integration between farm gate and export price series, the price adjustments may not happen instantaneously. There could be some disequilibrium in the short run. The error correction model usually takes into account the adjustment of short-run and long-run equilibrium in markets, as well as time required to remove disequilibrium in each period. The adjustment vectors for the market pairs derived from error correction model are presented in column 7 of Table 7. The results show that, about 9–48% of disequilibrium is removed in each period. This implies that the exporting firms take between six weeks and five months to adjust to long-run equilibrium. As expected, other firms require longer time for adjustment to shocks when compared with the major players.

As expected from economic point of view, positive and significant relationship exists between farm gate price series and each of the export price series. The results show that the coefficients of border prices are less than one. A one Naira increase in border prices only increases the farm gate prices by between 0.604 and 0.834 Naira. Also, the bigger firms have lower pass-through coefficient than the other firms. The present deregulation policy which enhances farmers' access to price information through mass media and healthy competition among stakeholders along the supply chain might have favoured improvement in the market efficiency. Given lack of evidence of market power tendency, the temporary divergence between each major firm export price series and farm gate might be due to short-term contracts which the exporting firms have with foreign buyers, various capacity constraints, and/or exchange rate shocks.

Table 7: Cointegrating coefficients for farm–firm relationships

Market pair	Independent	Beta	D1	D2	D3	Adj. Coeff.
Farm gate-Agro Trader	Agro Trader	0.636*** (0.076)	5.120*** (1.251)	4.760** (1.280)	9.308*** (1.217)	0.477 (0.158)
Farm gate-Stanmark	Stanmark	0.691*** (0.105)	4.405*** (1.656)	4.539*** (1.636)	8.413*** (1.709)	0.450 (0.105)
Farm gate-Cocoa Products	Cocoa Products	0.487** (0.127)	-	-	-	0.440 (0.151)
Farm gate-others	Others	0.834*** (0.040)	-0.313 (0.524)	-2.957*** (0.606)	-0.667 (0.608)	0.097 (0.375)

Farm gate-Border	Border	0.728*** (0.069)	3.787*** (0.976)	3.517*** (0.984)	6.654*** (1.030)	0.691*** (0.207)

In parentheses are the standard errors; *** denotes significant at 1% level, ** significant at 5%, and * significant at 10%; D denotes first difference.

The degree of vertical integration between border (average export price series) and farm gate are also tested with multivariate Johansen's lambda-max (LM) and trace tests. Equation 4 is the relevant model for farm gate-border price series combination. The results, presented in Table 7, indicate strong positive and significant long-run relationship between the pair. The adjustment vectors for the market pair shows about 69% disequilibrium is being removed in each period from export market to farm gate.

6. Summary and conclusion

The primary objective of this study is to assess cocoa price transmission in a vertically-related set-up to test for the tendency for market power among emerging exporters under liberalized market. To fully understand the structure of the market in the post-reform period, graphical illustration of the market integration, both horizontal and vertical, is supplemented with time series tests within cointegration and error correction framework. The results show that, there is co-movement of farm gate prices among the cocoa producing states. This implies that the local markets in cocoa producing states are integrated with each other, an evidence of market efficiency. Pair-wise market integration also indicates that the local markets are well-integrated with the border.

The analysis of price transmission based on firm-specific export price data shows that none of the firms tend to exert market power over the cocoa farmers, unlike the situation that led to abolition of cocoa marketing boards in 1986 (Delgado, 1986). This also suggests that the efficiency of cocoa international marketing channel improves as a sequel to market liberalization. It is highly probable that government abolition of cocoa marketing boards contributed to this development. Given lack of evidence of market power tendency, the temporary divergence between each major firm export price series and farm gate might be due to short-term contracts which the exporting firms have with foreign buyers, various capacity constraints, and/or exchange rate shocks.

The adjustment vector for the farm-firm price relation indicates that about 19-48% of disequilibrium is removed in each period, that is, one month. This implies that the exporting firms take between six weeks and five months to adjust to long-run equilibrium. Cocoa Products is the slowest to return to long-run equilibrium, while Agro Trader is the fastest. Early entry into the export business following market liberalization, and better access to bank credit might have given Agro Trader an edge over other exporting firms. Another major finding of the study is that the border price is highly integrated with the world price. The replacement of cocoa marketing boards with exporting firms seems to have made cocoa prices more competitive in the domestic market and enhanced integration with the world price.

Given the signal for high level of efficiency in Nigerian cocoa market:

1. Government should continue to support the private sector to operate freely since their activities are income-enhancing for the poor cocoa farmers who mostly depend on the market to improve their productivity.
2. In order to control temporary price divergence, institutions that facilitate contracts enforcement should be strengthened. This could be done through trade association mediation.

3. Now that there is no tendency for private sectors to create barrier to cocoa trade, government should improve transportation infrastructure and create stable exchange rate of the nation's currency against the currency of the consuming nations to sustain integration of the markets.
4. Adequate flow of market information should be maintained since this seems to have benefited the farmers fairly well, particularly from upward movement in world price series.

Finally, some of the limitations of the results should be noted. First, annual price data is used to test for integration among the producing states' price series. Though, sample bias is controlled via bootstrapping the ADF, increasing the sample length might have given different picture of the market fragmentation.

Second, the farm gate prices were constructed as the average of all state-level farm gate prices, and tested for integration with individual exporter's border price. If the exporters operate in distinct geographical areas, this can produce a misleading result. The reports from the companies' data files show that the agents of the exporters' source for cocoa beans across all the producing states, regardless of the location of the firm and shares of cocoa sourced from different locations, are not consistently recorded. The use of the average of all producing states is thus suitable for this kind of analysis.

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Appendixes

Appendix A

Table A1: Major cocoa companies in Nigeria

Name of the company	Business type	Province/ State	City	Annual Sales Vol. (US $m)	Min order (mt)
Agro Traders Limited	Manufacturer, Trading and exporting company	Ondo	Akure	> 1	500 – 1000
Association of farm produce of Nigeria	Trading company	Lagos	Ikeja	< 1	1000
Billcell Beverages group of company	Manufacturer, trading company, Agent, distributor, wholesaler	Lagos	Lagos Island	> 1	1000
C. A. A. Company	Trading company	FCT	Abuja	> 1	-
Cocoa products (Ile-Oluji) ltd	Processing and exporting company	Ondo	Ile-Oluji	>2	1000
Colefarm company	Manufacturer	Lagos	Ikeja	> 1	-
Coop cocoa	Trading company	Ondo	Akure	1– 2.5	-
Dave Agriculture Ltd	Manufacturer	Kano	Sharada	< 1	-
Dangote Nig. Ltd	Trading company, distributor /wholesaler, Government, ministry, bureau commission	FCT	Abuja	> 100	600
Feeneone International	Trading company	Ogun	Oru	1– 2.5	1000
FENNY Global Services	Manufacturer, trading company, agent, distributor,	Edo	Edo	<1	1000
HOLLASIM Nigeria Ent. Limited	Trading Company, Agent, Government ministry/ Bureau/ Commission, Business Service (Transportation, finance, travel, ads, etc), Other	Oyo	Ibadan	< 1	-

HAMOSAD Nigeria Limited	Trading company	Oyo	Ibadan	50–100	1000
JABFAL	Manufacturer, and trading company	Ondo	Akure	50–100	1000
JOSSY Nigeria Limited	Trading company, Buying office, Agent, distributor	Osun	Ife	2.5 – 5	1000
OBJ Farm	Trading company	Lagos	Ikoyi	1–2.5	1000
OYOBIO Oil (Nig) Ltd	Manufacturer, trading company, agent, distributor	Lagos	Lekki	>1	1000
Producer of Africana seed	Manufacturer and trading company	Lagos	Ketu	> 1	150 bag
Robert Leo Farm Ltd	Manufacture	Kaduna	Kaduna	>1	1000
Rotkenb Nig Ltd	Trading company	Lagos	Apapa	> 1	1000
Stanmark Cocoa Processing Com.	Manufacturing and Trading company	Ondo	Akure	> 1	1000
Sunifam Ltd	Trading company	Akwa Ibom	Ikot Ekpene	>1	1000
Yinka group of company	Trading company	Nigeria	Lagos	> 1	1000

Source: www.alibaba.com, National Export Promotion Council (NEPC)

Appendix B

Table B1: Data sources

Variable	Description	Sources
Exporters prices, and supply, taxes, levies and inspection fees	Monthly series between year the firm started operation to 2008/2009 season	Each company data sheet and newsletters
Ondo, Oyo and Ogun State prices production and export	Average annual data (1986–2009)	Produce Departments of Ondo, Oyo and Ogun states' ministries of Agriculture
Western, Northern and Midwestern states prices, production and export	Average Annual data (1960/61 -1975/76)	Nigerian Cocoa Board statistical information at Cocoa Research Institute, Ibadan.
National aggregate price, production and export	Annual data (1961–2009)	Central Bank of Nigeria statistical bulletin, National bureau of Statistics
Monthly consumer price indices (1985 = 100)	Monthly series	Central Bank of Nigeria statistical bulletin
Cocoa boarder price in Nigeria	Monthly and aggregate	National Bureau of Statistics, Central Bank of Nigeria Publications, and FAO statistical database
World cocoa prices	Monthly series (f.o.b)	International Cocoa Organization (ICCO) database.
Exchange rate of naira to US dollar	Monthly series	Central Bank of Nigeria Statistical bulletin

Appendix C: Basic Data

Table C1: Stanmark cocoa export price in Naira per tonne

Year	January	February	March	April	May	June
2000	82879.34	84854.87	85689.54	86604.63	82089.6	82832.16
2001	91775.22	96632.25	100624	101610.8	106059.4	97400.44
2002	131794.7	132164.8	143146.9	147734.8	148269.1	150737.1
2003	190605	196709.4	190740	212071.1	180906.9	175778.1
2004	202759.2	185446.8	187000.8	178680.2	168900	160073.3
2005	197000	200044.7	198760.7	195000	190760.5	196553.2
2006	179124.4	173285.7	169607.1	167567.4	166368.7	155000
2007	202041	202025.3	210806.8	216686.4	214300.8	214048.8
2008	245778.8	266416	273105.8	279963.6	286993.6	294200.2
2009	245800	378030	246800.7	362955	352905	388080

Year	July	August	September	October	November	December
2000	85598.4	80978.82	86754.16	87896.56	80000.64	78501.88
2001	103609.8	103029.5	102891.3	107353.6	107678.9	104454.9
2002	157403.1	164820.5	165738	190666.9	191073.7	191149
2003	176990.6	180750.9	178000.5	177650.8	190440.4	200777
2004	191008.2	213856.3	191200.8	191447.6	195700.8	203344.1
2005	187220	185248	157484.6	161000	161340	190223.6
2006	206804.5	165770	165700	164778.8	165200	215527.2
2007	213679.2	212822.4	221029.2	212618.2	210210	206867.5
2008	301587.7	309160.7	300609	205145.5	209500	209500
2009	388080	390090	403155	448380	473505	498630

Table C2: Agro Trader cocoa export price in Naira per tonne

Year	January	February	March	April	May	June
2000	79363	85312	86203	85586	86399	85680
2001	91294	98237	97542	96625	98390	97397
2002	131795	120711	124359	126425	122210	127624
2003	171545	171882	179931	177044	174908	174871
2004	213373	184500	185688	178600	166000	177900
2005	197000	200888	223747	195332	191665	197664
2006	181198	173286	179312	157207	152879	152856
2007	202041	202474	202285	189420	197246	193536
2008	247098	253910	260910	268103	275495	283090
2009	240500	241800	241150	356000	348000	386000

Year	July	August	September	October	November	December
2000	85063	84087	82862	82217	79801	84963
2001	95598	94211	93242	92324	91497	90986
2002	133554	135735	136490	150758	148732	151041
2003	179389	180723	181941	181233	190867	212005
2004	190000	216911	195444	190776	203823	202800
2005	185000	185200	178000	185002	163080	163314
2006	152856	166791	166726	184006	165900	184006
2007	192845	191895	195227	194871	188348	185353
2008	290894	298914	307154	205154	210810	216622
2009	387000	392000	398000	437000	487000	499000

Table C3: Cocoa Products Ltd. export price in Naira per tonne

Year	January	February	March	April	May	June
2006	177777.6	171982.8	193422.1	187000	186500.4	185000
2007	212944.8	200101.2	243485	245062	242364	254820
2008	257539.4	264024.5	270672.8	277488.5	284475.9	291639.2
2009	225000	225000	225000	360000	350000	385000

Year	July	August	September	October	November	December
2006	172328.5	164326.4	181715.3	181000.6	172447.8	187400.7
2007	254380	212822.4	216518.4	231757.3	226017.8	222423.9
2008	298983	306511.6	280654.8	193285.4	198152.5	203142.1
2009	385000	387000	400000	445000	470000	495000

Table C4: Farm gate price of cocoa in thousand Naira per tonne

Year	January	February	March	April	May	June
2000	76500	81600	84150	81600	76500	76500
2001	82664	87450	90365	93280	93280	76848
2002	123360	131070	115650	115650	115650	123360
2003	160000	165000	145000	150000	99788	106570
2004	175000	140723	142673	126398	116401	103835
2005	145345	122870	140109	174120	126821	127391
2006	122500	122500	119000	112000	112000	86567
2007	112000	112000	115500	119000	119000	126000
2008	189141	200000	170000	160000	165000	170000
2009	136545	210000	130572	200000	180000	190000

Year	July	August	September	October	November	December
2000	76500	76500	79050	81600	79233	69097
2001	93280	99110	99110	104940	104940	104940
2002	123360	134925	138780	138780	142635	146490
2003	115436	119427	123054	107802	113121	121931
2004	142938	170000	151979	128594	138196	142373
2005	98443	119000	119000	109754	115940	136500
2006	119000	106668	112278	107035	112683	147000
2007	129500	119000	133000	136500	143500	140000
2008	180000	190000	199189	126289	138392	141138
2009	200000	210000	250000	280000	290000	350000

Table C5: ICCO monthly cocoa prices in Naira per tonne, 2000–2009

Year	January	February	March	April	May	June
2000	90392	85593	93866	91027	91439	95584
2001	106312	127490	123853	122463	122590	108865
2002	156998	170448	183961	181448	186305	197465
2003	276529	284345	260016	244785	222518	201186
2004	220157	211276	201566	191160	187347	186189
2005	205074	216345	232621	209904	199986	203726
2006	204772	199475	198012	198645	204002	205420
2007	216392	230605	244630	250788	253525	255023
2008	259015	294885	312001	306967	314019	352722
2009	373867	386299	367529	373057	364890	396860

Table C5: continued

Year	July	August	September	October	November	December
2000	98259	89925	89961	89545	81711	86290
2001	107689	114998	113305	120531	138364	150380
2002	231964	245086	272593	277985	229182	255648
2003	198676	200524	209131	191578	205662	222491
2004	206325	228835	203857	196560	220037	218205
2005	197099	195247	194060	187443	184116	195014
2006	214416	205899	200292	195451	202019	217549
2007	272700	239996	242954	237232	235784	248581
2008	344652	327867	312481	262710	241223	317358
2009	411219	429572	475736	501882	509375	521795

Table C6: Monthly consumer price index (all item, 1985 = 100)

Year	January	February	March	April	May	June
2000	3271.7	3311.6	3347.2	3414	3521.7	3673.6
2001	3848.9	3927.3	3956.4	4207.1	4330.2	4263.5
2002	4562.2	4634	4644.1	4744.1	4771.1	4784.4
2003	5046.2	4971	4916.4	5136.3	5184.9	5454.5
2004	6175.2	6206.3	6020.8	6037.2	6211.8	6221.8
2005	6783.9	6885	6999.5	7118.8	7253.6	7378
2006	7512.8	7631.1	7842.6	8015.8	8021	8005.4
2007	8109.1	8171.3	8254.3	8352.8	8394.3	8518.7
2008	8803.9	8829.8	8897.2	9037.2	9208.3	9545.3
2009	10037.9	10115.6	10174.2	10234.2	10421.5	10613.4

Year	July	August	September	October	November	December
2000	3656.1	3740.4	3792.4	3815.5	3763.3	3778
2001	4350.7	4440.2	4517.3	4553.1	4419.2	4401.7
2002	5028.2	4985.6	4967.9	4797.6	4956.2	4937.3
2003	5677.4	5608.8	5879.6	5926.3	6009.2	6112.9
2004	6284	6335.9	6418.8	6564	6615.9	6729.9
2005	7927.6	8124.7	7979.5	7787.6	7616.5	7502.5
2006	8166.1	8425.1	8477.2	8264.7	8207.6	8145.4
2007	8560.2	8783.1	8824.6	8643.1	8632.8	8679.4
2008	9752.7	9866.8	9975.7	9913.4	9910.3	9986
2009	10836.3	10955.6	11012.6	11064.5	11137.1	11178.5

www.nigerianstat.org
www.valuefronteiraonline.com/public_upload/file/cpi%20sep.pdf

Table C7: Monthly exchange rate (AFEM/DAS) Naira to US dollars

Year	Jan	Feb	Mar	Apr	May	Jun
2000	98.4905	99.6274	100.6081	99.8783	100.5976	101.5142
2001	109.9977	110.1925	110.1556	113.2263	113.5524	111.975
2002	113.4159	114.2526	115.5579	115.6286	116.05	119.045
2003	126.5718	126.9844	130.352	126.983	127.1684	127.401
2004	135.5357	134.6553	133.9829	132.99	132.5119	132.25
2005	132.38	132.3532	132.3525	132.3525	132.3195	132.3694
2006	129.785	129.1033	128.2356	127.9622	127.9449	127.8559
2007	127.1408	127.1335	127.1335	126.8398	126.4564	126.4564
2008	116.8918	116.8754	116.8365	116.7917	116.7523	116.7274
2009	142.3713	145.9059	146.4275	146.0009	147.0893	146.9658

Year	Jul	Aug	Sep	Oct	Nov	Dec
2000	104.895	102.435	101.8619	101.9773	102.0205	107.3823
2001	111.3455	111.1978	111.1	111.1	111.5167	112.4864
2002	124.1368	125.0086	125.9653	126.0553	126.3294	126.3883
2003	127.3226	127.6052	128.1736	129.2755	136.1067	136.7314
2004	132.2991	132.3291	132.3445	132.3815	132.3718	132.3578
2005	132.369	131.752	129.0152	129.0444	128.3957	128.501
2006	127.8833	127.8251	127.7847	127.7769	127.765	127.782
2007	126.6811	126.1749	125.3579	123.9018	119.8797	117.6365
2008	116.6856	116.6591	116.6428	116.6419	116.6614	129.1602
2009	147.3191	145.2897	151.3703	148.8159	150.5187	149.1876

Appendix D

Test for cointegration and causality

Engle and Granger (1987)

Consider the following single equation:

$$p_{it} = \beta p_{2t} + \mu_t \qquad \text{(a. 1)}$$

If μ_t is non-stationary, then $p_{it} - \beta p_{2t}$ is not a cointegrating relationship. Engle and Granger suggest estimating the above by OLS and applying unit root tests such as the ADF and Phillip Perron Zt or Zp to the estimated residuals $\hat{\mu}$, in order to test the null hypothesis of no cointegration. For a discussion on the issues related to Engle and Granger method (see Maddala and Kim (1998).

Johansen (1988, 1991)

Consider a vector autoregression (or VAR) of two variables p_{1t} and p_{2t}. A VAR expresses a vector of variables as a linear sum of a set of lags of itself. A simple case of a VAR between two variables is:

$$\begin{pmatrix} p_{1t} \\ p_{2t} \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix} + \begin{pmatrix} a_1 & a_2 \\ a_2 & a_2 \end{pmatrix} \begin{pmatrix} p_{1t-1} \\ p_{2t-1} \end{pmatrix} + \begin{pmatrix} v_{1t} \\ v_{2t} \end{pmatrix} \qquad \text{(a. 2)}$$

The issue of cointegration can once again be addressed by looking at the VAR, but extending it to contain a second lag. An example of a VAR(2) would be

$$\begin{pmatrix} p_{1t} \\ p_{2t} \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix} + A_1 \begin{pmatrix} p_{1t-1} \\ p_{2t-1} \end{pmatrix} + A_2 \begin{pmatrix} p_{1t-2} \\ p_{2t-2} \end{pmatrix} + \begin{pmatrix} v_{1t} \\ v_{2t} \end{pmatrix} \qquad \text{(a. 3)}$$

This has the Vector Error Correction (VECM) representation:

$$\begin{pmatrix} \Delta p_{1t} \\ \Delta p_{2t} \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix} + (A_1 + A_2 - I) \begin{pmatrix} p_{1t-1} \\ p_{2t-1} \end{pmatrix} + \begin{pmatrix} v_{1t} \\ v_{2t} \end{pmatrix} \qquad \text{(a. 4)}$$

The rank of the matrix $(A_1 + A_2 - I)$ is equal to the number of cointegrating vectors. If the rank of $(A_1 + A_2 - I)$ is equal to two, then both variables can be shown to be stationary. If the rank of $(A_1 + A_2 - I)$ is zero then the series are not cointegrated, whilst if the rank of $(A_1 + A_2 - I)$ is one then the variables are cointegrated.

Therefore, in case of two variables, cointegration can be tested by testing the significance of the characteristic roots or the eigenvalues of $(A_1 + A_2 - I)$. If the variables are not cointegrated the characteristic roots $\lambda 1$, $\lambda 2$ are equal to zero. Similarly, if the rank of $(A_1 + A_2 - I)$ is equal to one, $0 < \lambda 1 < 1$ and $\lambda 2$ is equal to zero. Johansen (1988; 1991) derived the distribution of two test statistics for the null of no cointegration referred to as the Trace and the Maximum Eigenvalue test:

$$\lambda_{trace} = -T\sum_{i=1}^{2} \ln(1 - \hat{\lambda}_1) \qquad \text{(a. 5)}$$

$$\lambda_{\max} = -T \ln(1 - \hat{\lambda}_2) \qquad \text{(a. 6)}$$

The first statistic tests the null hypothesis that the number of independent cointegrating parameters is less than or equal to two, whilst the second statistic test the null hypothesis that the number of cointegrating parameters is one against the alternative of two cointegrating parameters.

Error correction representation of cointegrated equation or system

Johansen derived an error correction representation of a cointegrating system. He defined two (n x r) matrices α and β, where n is the number of variables and r is the rank of (A1 + A2 – I). The properties of these matrices are:

$(A_1 + A_2 - I) = \alpha\beta'$ (a. 7)

The matrix β is the matrix of cointegrating parameters, whilst the matrix α represents the adjustment of the variables towards the long-run equilibrium, if it exists. In the case of two variables, such as p1t and p2t, the error correction model (ECM) is as follows:

$$\begin{pmatrix} \Delta p_{1t} \\ \Delta p_{2t} \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix} + \begin{pmatrix} \alpha_1 \\ \alpha_2 \end{pmatrix} (p_{1t-1} - \beta_{t-2}) - A_2 \begin{pmatrix} \Delta p_{1t-1} \\ \Delta p_{2t-1} \end{pmatrix} + \begin{pmatrix} v_{1t} \\ v_{2t} \end{pmatrix} \qquad \text{(a. 8)}$$

β represents the long-run multipliers, where a rank restriction has been imposed:

$$\frac{a_2}{1 - a_1} = \frac{a_1}{1 - a_2} = \beta \qquad \text{(a. 9)}$$

In this case, the lack of a cointegrating relationship would also imply no granger causality between the series, but if only $A_2 = 0$. More generally, Granger causality does not require cointegration. However, cointegration does imply causality in at least one direction.

Granger causality

The estimated bi-variate ECM for each market pair takes the following form:

$$\Delta Pit = \alpha 0 + \sum \alpha 1i\, \Delta Pit\text{-}1 + \sum \alpha 2i \Delta Pjt\text{-}1 + \varphi ECTit\text{-}1 + u1it \qquad (a.10)$$

(i=1…n1) (i=1…n2)

$$\Delta Pjt = b0 + \sum b1i\, \Delta Pjt\text{-}1 + \sum b2i \Delta Pit\text{-}1 + \varphi ECTit\text{-}1 + u2it \qquad (a.11)$$

(i=1…n1) (i=1…n2)

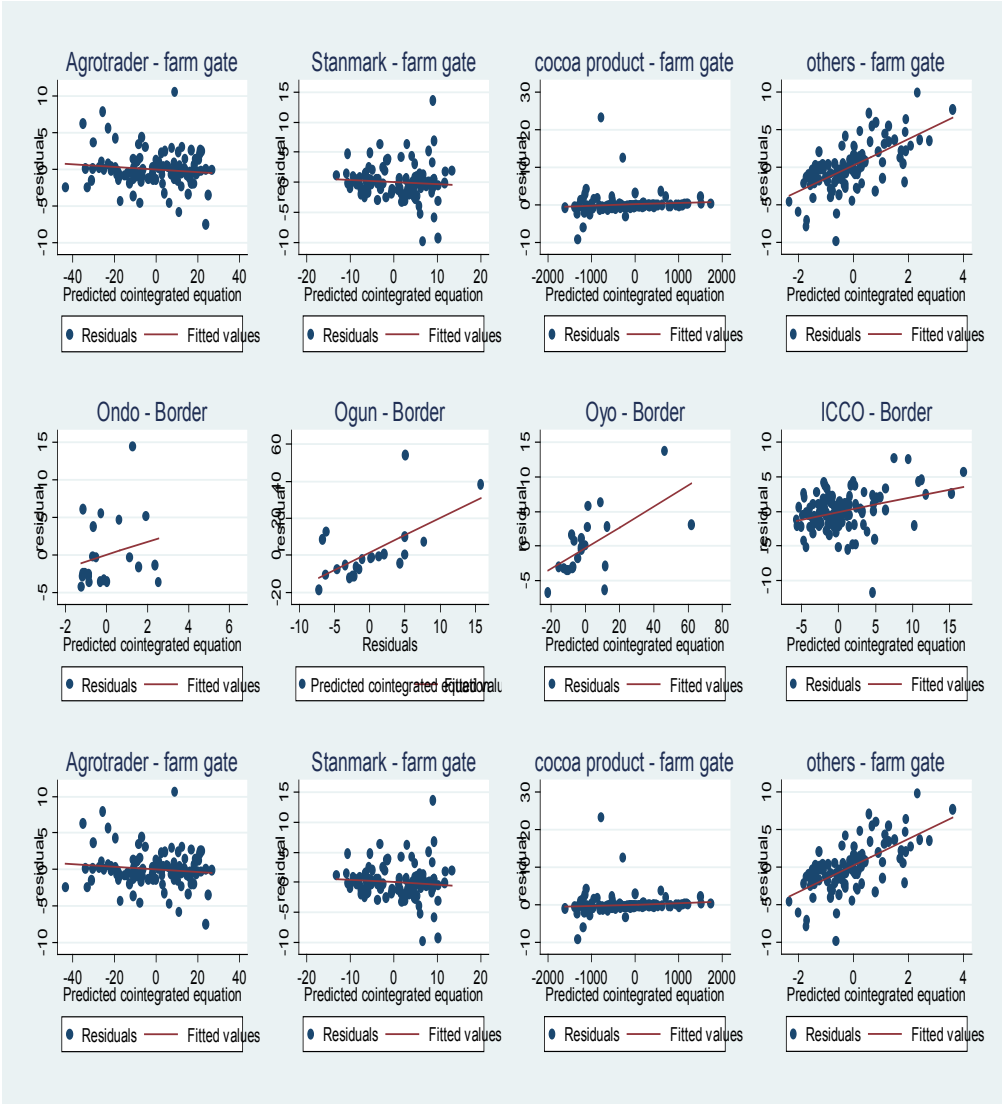
where Δ is the difference operator, Pit and Pjt are the real prices of cocoa of the market pairs. ECTit-1 is the error correction term derived from the long-run cointegrating relationship, u1t and u2t are the white noise error terms *t* denotes the years and *n1*, *n2* are the lag orders of α's and b's, respectively.

An advantage of the VECM results is that it distinguishes between short-run and long-run Granger causality. The coefficients of the lagged error correction term show that there is a long-run causal relationship between the price series. It also indicates that the prices are adjusting to their long-run equilibrium relationships. The coefficients (and the magnitudes) of the ECM indicate the speed of adjustment to the long-run equilibrium relationship.

If φ is statistically significant in the first equation, but not significant in the second, then we say that Pjt Granger causes Pit, if the opposite happens we say that Pit Granger causes Pjt. If φ is significant in both equations we say that there is a bi-directional relationship.

Appendix E

Figure E1: Residual plots



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