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An Investigation into Product Market Integration in the Economic Community of West African States (ECOWAS)

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Abstract

This study examines the extent of market integration within the West African sub-region using the theory of "law of one price". The dataset covers three countries: Nigeria, Benin and Togo accounting for about three quarters of the sub-region economy. The data covers highly disaggregated retail level prices from the three countries and distance data between the three countries from 2011m1 to 2015m12. The results show that relative price dispersion within country is less than between countries. It is also shown that distance and border effects have positive and significant effects on price dispersion. The effects of distance became more significant as the magnitudes of the coefficients of border and distance increased after controlling for product, time and country pair effects. This result supports the hypothesis that product market integration in ECOWAS, like other developing regions, is weaker than in developed regions. This shows that there is the need to reduce the institutional constraints disrupting free flow of goods and services within the sub-region.

Keywords: Product Markets, Integration, Law of One Price, ECOWAS

JEL Classification: D49, F15, N47, K39

1. Introduction

Inter-regional trade within West African sub-region has been identified as one of the lowest in the world compared to other regions. For example, inter-regional trade accounts for between 12 percent and 15 percent of total trade for ECOWAS, 24.1 percent for ASEAN and 43.8 percent and 64.4 percent for NAFTA and EU respectively. Yet, regional economic blocs are expected to increase trading possibilities among member countries and integrate product markets. They also drive the emergence of single and larger market, help to stimulate production and consumption and through these facilitate optimal allocation of resources. Consumers can also gain from diversified product supply and price reduction which increases their spending power. Under a single market system, there will be a synchronous movement of prices among geographically dispersed markets, which is considered as product market integration.

Market integration halts price differences in the long run in integrated markets since price movements in one market would result in price adjustments to regain equilibrium relationships among prices observed in geographically separated markets, promotes efficient allocation of resources (Frankel and Romer, 1999), enhances efficient allocation of static efficiency (Balchin, 1997), ensures that a regional balance occurs among surplus areas and deficit areas within a country or within a region (Goletti, Ahmed, and Farid, 1995) and reduces price volatility and facilitates movements of goods from surplus areas to deficit areas. On the other hand, market segmentation limits the number of variety of products available to consumers and prevents specialization of production which leads to inefficiently higher prices, reduces profit to producers and generates welfare cost for the society.

Poor market integration and market segmentation has dominated African economies for many reasons. For example, Africa consists of many landlocked economies; many countries with low population densities and low income levels, small markets, and many spatially dispersed and disconnected rural communities (Balchin, 2015). These challenges result in high trade costs which impede trade flows leading to fragmented, uncompetitive and disconnected domestic markets (World Bank, 2012). Hartzenberg (2011) recorded that in 2008 twelve Sub-Sahara African countries had populations of less than two million while nineteen had GDP less than five billion US dollars each, six of which had a GDP less than one billion dollars each. As for ECOWAS, in 2015, four countries had a population of less than five million each, six less than 10 million and in fact all countries, except Nigeria, had populations less than 30 million each.

A main objective of the ECOWAS which is to foster economic integration among member countries so as to reduce the problem of small markets has not been achieved. According to USAID (2015), in 2014 the share of the intra community trade was less than 15 percent of total ECOWAS trade volume and the share of intra-ECOWAS exports is less than 10 percent of total exports. Overall, regional integration has not been remarkable for Africa and ECOWAS in particular

Different policies have been formulated to reduce tariffs and other natural barriers arising from distance and geographical irregularities among ECOWAS countries since it was established in 1975. In recent years regional integration is being pursued vigorously as evident in the notable reductions in tariffs and especially for intra-ECOWAS trade. The reductions in these barriers have been accompanied by the increased use of NTBs thus making it difficult to say a priori how much the product markets have become integrated in recent years.

Despite its importance, only a limited research in the area of market integration had been conducted in developing countries particularly in Africa. This is largely because the requisite disaggregated price data for narrowly defined goods are unavailable in developing countries and have therefore precluded studies in the area. Therefore, literature on the subject is almost entirely dominated by studies conducted for developed countries such as Engel and Rogers (1996). There are, however, some recent studies for Southern Africa (Nchake, 2013), and for ECOWAS (Aker, 2010, 2014).

Therefore, little is known about the outcomes of the various mechanisms to enhance regional integration within and between ECOWAS member countries and there been no comparison of different outcomes of market integration efforts between different countries in the region. All these necessitate the need to study product market price integration in the ECOWAS.

This study therefore set out to fill this gap by studying the extent of product market integration in ECOWAS. This is done through three different quantitative measures. First, it estimates the price dispersion between and within countries in ECOWAS. Second, it estimates the border effect between Nigeria and its two neighbors, Benin and Togo. Three, it estimates the influence of distance on price dispersion among these three countries. This is the first study to our knowledge that is doing this and this makes it very unique in this regard. This study focuses on the adjacent countries of Benin, Nigeria and Togo in ECOWAS for many reasons. These countries have all been members of ECOWAS since it was founded in 1975. The three countries cover 22.43 per cent of total land area of ECOWAS and 57.55 per cent of its population and have a combined economic weight of 76.64 per cent of the region's economic weight. The dataset consists of highly

disaggregated price data collected at the outlet level for the selected three ECOWAS countries and distances between cities within and between countries in ECOWAS. It covers a period of sixty months from January 2011 to December 2015 which represents a period of stable trade policy in the region.

Our results suggest that, for the three countries chosen for this study in ECOWAS sub-region, Nigeria, Benin and Togo, product market integration is limited. Specifically, we find that relative price dispersion within country is less than price dispersion between countries. Also, distance and border dummy impact positively and significantly on price dispersion and the effect of distance increases more significantly as the magnitude of border and distance increases after controlling for product, time and country pair fixed effect. Additionally, seasonal impacts of January and December are insignificantly even though the prices of commodities usually change more in the two periods compared to other months. Broadly, these results support our hypothesis that product market integration within West African sub-region is not grounded like other regional groups in developed and developing countries.

The rest of the article is organized as follows: Section two describes the theoretical literature that anchors the study, the Law of One Price, and reviews some empirical literature. Section three discusses the data source and the methodology. Section four contains the empirical findings, while section five concludes.

2. Literature Review

Product market integration in this study is anchored on the law of one price which states that geographically separated markets are spatially integrated if goods and information flow freely among them and when the effects of price changes in one market induce a price change in the same direction and of the same degree in the other markets. Thus, the law of one price product (LOP) provides a theoretical benchmark for assessing market integration as it defines the extent and grade of market integration.

Mathematically, the absolute version of the LOP (Rapsomaniks, Halla, and Comforti (2011) which is the basic framework for analysis of market integration states that for any product *x*,

$$P_{xk} = E\ P'_{xj} \text{---------- (1)}$$

where P_{xk}= Price of '*x*' in market *k*.

P'_{xj}= Price of 'x' in market j.

E= nominal exchange rate, the home currency price of foreign currency,

This formulation is used to consider price variations within and between countries.

In general, the spatial arbitrage condition is

$|P_{xj} - P_{xk}| \leq t_{xjk}$---------- (2)

From this, three possible trade regimes can be distinguished that correspond to different levels of market integration (Baulch, 1997).

The first is described quantitatively as

$P_{xj} + t_{xjk} = P_{xk}$---------- (3)

where$P_{xj}$is the price of the product x in market j

P_{xk}= price of product x in market k

t_{xjk}= transactions costs of moving product x between the two markets, j and k.

Accordingly, LOP theorizes that the relationship between the prices is depicted as

$\left|P_{xj} - P_{xk}\right| = t_{xjk}$----------(4)

such that the spatial arbitrage conditions are biding.

In the second regime, structural differences in prices existing between the two markets are less than the transactions costs associated with trade between them in (4):

$P_{xj} + t_{xjk} > P_{xk}$----------(5),

and spatial arbitrage conditions are not binding:

$|P_{xj} - P_{xk}| < t_{xjk}$----------(6)

The third trade regime is given by

$|P_{xj} - P_{xk}| > t_{xjk}$----------(7)

In this third regime, the structural differences in prices exceed trade costs and the spatial arbitrage conditions are violated. It is profitable to trade between the two markets but trade is prevented by some barriers.

Empirical works on product market integration have shown different results across different trading regional blocs, Engel and Rogers (1996) used aggregate prices to estimate the impact of crossing US – Canada border to be equivalent to shipping a good 75,000 miles. But Gorodnichenko and Tesar (2009) revealed their result was driven by cross-country heterogeneity in the distribution of within country price differentials rather than the between-country price differences the border effect is supposed to capture. Other researchers using other methodologies found smaller border effect (see Broda and Weinstein (2008) McCallum (1995).

In Versailles (2012) a distance of 100km between 2 cities allows for departures of around 13% from the LOP for East Africa. This is, higher than Broda and Weinsten (2008) or Engel et al. (1996) for the US – Canada, showing unsurprisingly that distance plays a much bigger role in Eastern Africa. This is also higher than the 7% estimated by Engel et al (2005) for the US – Canada border and higher than the 2 – 3% found by Aker *et al.* (2010) for the Nigerian – Niger border. Studies also show that countries that are further apart have higher deviations from the LOP. Versailles (2012) showed prices being moved away from the LOP equilibrium by 24% for Burundi – Kenya city pair, but only by 11% for Burundi – Rwanda city pair.

The literature that examined the relationship between membership of custom union, monetary union, tariffs and products market integration using the quantity approach (gravity style model) forms the larger part of literature measuring the impact of custom and monetary unions on integration (Baier and Bergstrand, 2001). Martin and Mejean (2013) found that membership of monetary union reduces the price dispersion in the Euro Zone by almost 5 percent. The use of the gravity models and price indices to analyze price dispersion and market integration, however, suffers from a number of fundamental shortcomings.The common findings of these studies arethat membership of Custom/Monetary Union reduced price-dispersion andplay an important role in boosting trade since tariffs act as barriers to imports and thereby impede trade flows between countries.

Some other studies have also emphasised the importance of trade related infrastructure, removal of non-tariff barriers and market reforms in boosting trade flows (Olper and Raimondi, 2008). A large number of the price based studies, such as Asplund and Friberg (2001), Rogoff (1996), Engel

and Rogers (1996) and Wei and Parsley (1995)are based on aggregate price indices. These studies find that distance alone cannot explain the observe price volatility and persistence of LOP deviations across markets, the border effect (Rogers and Smith, 2001).

Results of Rogers, Parsley and Wei (2001) revealed higher variation in the prices of identical goods across cities located in different countries compared to cities in the same countries located at an equal distance apart, suggesting the failure of LOP due to border and distance related causes although the degree may differ depending on their membership of Custom or Monetary Union. Similar results were obtained from Bergin and Glick (2007), Goldberg and Verboren (2005), Nchake (2013) and Gophinath *et al,* (2010).

Because of theoretical limitations of the uses of price indices, there is a recent shift in the focus of empirical literature towards the use of data on actual prices to analyze dispersion in relative prices. Goldberg and Knetter (1997) stress the necessity of using micro level price data in order to understand deviations from LOP. Failures in LOP are evident in studies that uses disaggregated price data as manifested in Cavallo, Neiman and Rigobon (2013) and Frankel, Parsley and Wei (2012) which revealed wide dispersion in product prices within and between countries. These results are consistent with studies across large countries (Anderson, Schaefer and Smith, 2013), studies that use online prices (Cavallo *et al*, 2012), studies focusing on specific regions (Bradford and Lawrence, 2004) and studies which focus on group of countries (Moon, 2013).

The extent of prices dispersion across market may also depend on the nature and characteristics of the product (such as its composition and tradability) suggesting the importance of product heterogeneity. The findings of Crucini, Telmer and Zachariadis, (2005) is that the size of LOP deviation is larger for less tradable goods and for goods that use more non tradable inputs in production. They find the price dispersion to be about 10 percent higher for non-tradable goods across their sample of 122 countries in 79 countries. They also find higher cross country price dispersion for services and for goods which are subjected to additional taxes such as tobacco and alcohol.

On the whole, global price dispersion seem to be time variant (Bergin and Glick, 2007), location specific as it depends is on whether markets located in developed or developing countries (Knetter& Slaughter, 2001), and show that markets are segmented internationally (Crucini and Yilmazkuday, 2014).

Compared to developed countries, the numbers of studies that provide empirical evidence and therefore offer insight to product market integration in Africa are quite limited. Available literature is also narrow in focus (as analyses for non-agricultural products have generally been neglected) and scope (in the sense that few commodities are considered). An example of agricultural market integration study is Layade and Adeoye (2014). Aker, Klein, O'Connell and Yang (2014) studied border effect for only two countries (Niger and Nigeria) and two commodities (rice and wheat).

The general findings in the literature are that membership of monetary and custom unions reduces price dispersion across countries, countries that are further apart have higher deviations from LOP, global price dispersion seems to be the time variant and location specific and that markets are segmented internationally. This ECOWAS's study extends the literature by examining market integration within and between ECOWAS countries and thereby provides empirical evidence on whether the key stylized facts in the literature on price dispersion and market integration hold in the ECOWAS context.

3. Methods

Empirically, the relative version of LOP is the relative price of product i between markets j and *k* at time *t* which can be determined as the differences in the log prices of that product between the two markets.

$$RP_{ijkt} = P_{ijt} - P_{ikt} \text{---------- (3.1)}$$

RP_{ijkt} = the difference in the log prices of that product '*i*' between the two markets, *j* and *k*

P_{ijt} , P_{ikt} = price of the product *i* at market *j* and market *k*

Equation (3.1) will be the framework of our subsequent analysis of price dispersion within and between countries.

3.1 Mean Deviation from LOP

Between country relative price dispersion are calculated as the difference between the price of the product k, in market *i* and the price of the identical product k at another market j, *i*and j are located in different in countries.

$$M_{kijt} = E_{kij}\left[RP_{kij}\right] - - - - - -(3.18)$$

This study will focus on the means of price differentials to consider market integration

$$M\left|RP_{kijt}\right| = \sum_{k}^{k} \frac{R_{ijt}}{K} - - - - - -(3.19)$$

3.2 Cross Border Effect

Using the basic equation specified by Engel and Rogers (1996) as:

$$M_{kijt} = \propto_0 + \propto_1 dst_{ij} + \propto_2 bdr + \in_{ijt} - - - -(3.20)$$

$$Where\ bdr\ is\ border\ defined\ as\ 1\ if\ markets\ i\ and\ j\ are\ separted\ by\ national\ border$$

$$0\ if\ otherwise$$

dst is the log of the distance between the markets and $\propto_1$, $\propto_2$ are positive coefficients

The basic model is extended as follows to control for other observed and unobserved characteristics:

$$M_{ijkt} = \propto_1 border + \propto_2 dst_{ij} + \propto_3 dst2 + \sum_k r_k D_k + \sum_{ij} \delta_{ij} D_{ij} + \lambda_t + \in_{ijt} \ldots\ldots (3.22)$$

D_{ij}= *Vector of dummy variable for city pairs to control for traded effects specific to market pairs.*

$D_k = Vector$ *dummy variable for product K to control for unobserved heterogeneity across products.*

$\lambda_t =$ *Vector of monthly dummies to captive timed fixed effects.*

r_k *and* δ_{ij}*are product and market pair fixed effect respectively.*

4. Analytical Techniques

The main methods of analysis employed the ordinary linear regression (for model 1) and Least Square Dummy Variable, LSDV (for model 2) to study product market integration in ECOWAS. The model 1 examined the relationship between the transaction cost indicators (distance and border

dummy) and the absolute price dispersion. The model 2 examined the pure effect of the transaction cost indicators (distance and border dummy) on absolute price difference by controlling for product, time and country pair fixed effects. In addition to the transaction costs, this study included January and December (which formed part of time effects) in the model.

4.1 Data Sources and Measurement

The data for the study comprised of two types of dataset: the price database and distance database. The price database consisted of unique highly disaggregated micro-level retail level price data underlying the computation of the National Index of Consumer Prices (CPI) in Benin, Nigeria and Togo. The data which was not published was obtained from the National Bureau of Statistics, Lagos, Nigeria; the National Institute of Statistics and Economic and Demographic Studies, Lome, Togo; and the National Institute of Statistics and Economic Analysis, Cotonou, Benin, provided observations for prices of a range of narrowly defined product. The monthly data was collected to cover a period of five years from January 2011 to December 2015.For all products, the price concept used corresponds to price per unit.

The second data set comprised of the geographical distances between city pairs both within and between countries. The distance data was collected from geographical websites such as Google maps and Travel Matter. This dataset made it possible to calculate the shortest distance (by road) between city pairs within and between countries.

The uniqueness of the dataset was that it varies by product, price of the item, date of report (month, year), location, product category, the brand and packaging of the item. The use of product price at the retail level for this study facilitates the estimation of the long run levels of price differentials in different locations within the country, enhances the comparability of product prices between locations and minimizes the bias from aggregating heterogeneous products and in different locations.

The dataset of price reports underlying the CPI was organized for ease of monitoring the evolution of price of one individual product sold in one specific outlet over time. Month-to-month prices were used because it helps to isolate price differences that are associated with product market segmentation across locations and enables a time series analysis of product market integration across locations within and between countries.

Another important characteristic of the price report is that it takes the value added tax (VAT)into account in arriving at market prices. The sample data did not include the products whose prices are regulated as these are principally (and centrally) determined by government and not through the market system. Products whose prices are centrally set by the manufacturers not by the market area also excluded.

The final dataset covers only product categories for which the prices are recorded in a decentralized manner. To obtain a data set of comparable products across the countries that are as homogenous as possible, only six common products across the three countries were used. The selected products under consideration are; Girl Dresses, Men Shoe, Shirt Boys, Can Coke, Bath Towel and Women Shoe.

5. Discussions

This section focuses on the empirical analysis that establishes the degree of product market integration and appropriate channel by which border effects influence product market integration between the selected three (3) countries.

5.1 Summary Statistics

The Table 1 below summarizes the basic statistical features of absolute price dispersion for each of the selected products under consideration. The basic feature includes mean, median, minimum, maximum and standard. Also, the geographical distances of city-pairs between the three countries are presented in the lower portion of the table. Overall, there are evidences of wide variations (heterogeneity) across the product as shown by the differences between the minimum and maximum values as well as the standard deviation for the variables under consideration.

Focusing on the full sample, the result shows that the average (median) absolute price dispersion for across the selected products in the three countries is 1.115 (1.343) with the minimum and maximum values of 0.012 and 3.058 respectively. The median price dispersion of 1.855, 1.767 and 1.561 ranked Women Shoe, Can Coke and Bath Towel respectively the top three (3) products with the highest price dispersion. On the other extreme, the median values of 0.457, 1.294 and 1.362 ranked Shirt Boys, Girl Dresses and Men Shoe the top three (3) products with the least price dispersion.

The lower portion of the **Table 1** comprises of the geographical distances of city-pairs between the three countries. the shortest distance by road between Nigeria and Benin Republic as reported

in the is 698km while that of Nigeria and Togo is 864km, whereas Togo and Benin Republic which has the shortest distance between the three countries is 181km.

Table 1: Summary Statistics

Product	**N**	**Median**	**Min**	**Max**	**Mean**	**Sd**
Girl Dresses	180	1.294	0.012	2.360	1.116	0.597
Men Shoe	180	1.362	0.048	2.779	1.174	0.597
Shirt Boys	180	0.457	0.122	1.792	0.472	0.229
Can Coke	180	1.767	0.135	2.115	1.311	0.787
Bath Towel	180	1.561	0.043	2.861	1.195	0.705
Women Shoe	180	1.855	0.069	3.058	1.422	0.867
Full Sample	**1080**	**1.343**	**0.012**	**3.058**	**1.115**	**0.728**
	Shortest Distance Between Country					
Nigeria and Benin Rep.	698km					
Nigeria and Togo	864km					
Togo and Benin Rep.	181km					

Source: Author's Computation, underlying data from National Bureau of Statistics (NBS), Lagos, Nigeria, National Institute of Statistics and Economic and Demographic Studies, Lome, Togo and the National Institute of Statistics and Economic Analysis, Cotonou, Benin.

5.3 Correlation Matrix

Presentation of correlation analyses among the variables that are used in the basic model serve two important purposes. The first purpose is to determine whether there are bivariate relationship between each pair of the dependent and independent variables considered in this study. The second is to ensure that the correlations among the explanatory variables are not so high to the extent of posing multi-collinearity problems.

The result in Tables 2 shows that there is no evidence of multi-collinearity among the variables given the fact that the correlations among the independent variables (with the exception of Border Dummy and logDistance) are generally weak. Specifically, the result shows that positive association exists between absolute Dispersion and logDistance (r = 0.0081). Conversely, negative correlation (-0.0863) exists between Border Dummy and absolute Dispersion. Focusing on the relationship degree of association among the explanatory (independent) variables, the results shows that the association between Border Dummy and logDistance is positive and moderately

high (r = 0.6018). While this is true, the study proceeded to estimate variance inflation factor (VIF) to check whether this is capable of causing multi-collinearity problem.

Table 2: Correlation Matrix

	Deviation (Absolute)	logDistance	Border_Dummy
Deviation (Absolute)	1		
logDistance	0.0081	1	
Border Dummy	-0.0863	0.6018	1

Source: Researcher's Computation, underlying data from National Bureau of Statistics (NBS), Lagos, Nigeria, National Institute of Statistics and Economic and Demographic Studies, Lome, Togoand the National Institute of Statistics and Economic Analysis, Cotonou, Benin, 2018. logDistance = log of the shortest distance between the two countries (from Google maps) used as proxy for transaction cost. Border = dummy variable that explains the border effect (if countries i and j are separated by a national border and 0 otherwise).

5.4 Variance Inflation Factor

The study further checked if the estimates for the regression model can be uniquely computed because as the degree of multi-collinearity increases, the coefficients of the regression model become unstable and the standard errors for the coefficients can be inflated. Numerous authors emphasized that a VIF that is above 3 and a tolerance value that is less than 1 indicate no harmful effect of multi-collinearity. Judging from the result, the average VIF values are 1.57 (Table 4.3) which is far less than 3. Also, the corresponding reciprocal of tolerance are less than 1. These indicate that the linear relationship among the variables is not too high to the extent of posing multi-collinearity.

Table 3: Variance Inflation Factor

Variable	**VIF**	**1/VIF**
Border Dummy	1.57	0.638
logDistance	1.57	0.638
Mean VIF	**1.57**	

Source: Researcher's Computation, underlying data from National Bureau of Statistics (NBS), Lagos, Nigeria, National Institute of Statistics and Economic and Demographic Studies, Lome, Togo and the National Institute of Statistics and Economic Analysis, Cotonou, Benin, 2018. logDistance = log of the shortest distance between the two countries (from Google maps) used as proxy for transaction cost. Border = dummy variable that explains the border effect (1 if countries i and j are separated by a national border and 0 otherwise).

5.5 Price Dispersion within and between Countries

Table 4. Relative Price Dispersion within and between Countries

	2011	2012	2013	2014	2015	AVERAGE
BENIN and TOGO	**0.4881**	**0.5072**	**0.5187**	**0.4815**	**0.4655**	**0.4923**
NIGERIA and BENIN	**0.5209**	**0.4802**	**0.4835**	**0.4523**	**0.4836**	**0.4841**
NIGERIA and TOGO	**0.4155**	**0.4234**	**0.4233**	**0.4185**	**0.4102**	**0.4182**
NIGERIA	**0.0362**	**0.0473**	**0.0428**	**0.0839**	**0.0566**	**0.0534**

Table 1 reveals relative price dispersion within country (Nigeria) and between countries. Nigeria – Togo; Nigeria – Benin, and Togo – Benin between 2011 and 2015. The average price dispersion within Nigeria is 0.0534, between Nigeria and Benin is 0.4841, between Togo and Benin is 0.4922 and between Nigeria and Togo is 0.4182. The result is consistent with literature as the relative price dispersion between countries is larger than within country.

5.6 Relationship between Cross Border Effect, Distance Effect and Product Market Integration (Using Regression Approach)

Least Square Regression Analysis

From the result in column 1 of the Table 5 below, the F-statistic value of 6.658 (P = 0.001) rejects the null hypothesis that the explanatory variables are not jointly statistically significant in explaining variations in absolute price dispersion. This indicates a good fit. Moving to the effect of distance and border on the absolute price change, the result shows that LogDistance has positive and significant relationship with absolute price dispersion at 5% alpha level. These imply that a distances of about 100km causes about 9.9% deviation from LOP. Similarly, the coefficient of border dummy is positive and statistically significant at 1% implying that about 0.22 units of the price differences between the selected countries is as a result of the presence of a border.

Interpreting the result in column 2 of the Table 5, the F-statistic value of 138.8 (P = 0.000) suggests the rejection of the null hypothesis that the explanatory variables are not jointly statistically significant in explaining variations in absolute price dispersion. Also, the result shows that the effects of distance became more significant and the magnitudes of border and distance increased after controlling for product, time and country pair fixed effects. On the other hand, the coefficients of January and December are insignificant. This indicates that even though the prices of commodities usually change in the two periods compared to the others, these do not have significant effects on price difference between the countries.

Table 5: Least Square Regression Analysis

VARIABLES	(1) Model	(2) Model
logDistance	0.099**	0.757***
	(0.040)	(0.058)
	0.013	0.000
Border	0.220***	1.250***
	(0.060)	(0.102)
	0.000	0.000
Jan		-0.017
		(0.099)
		0.866
Dec		0.013
		(0.097)
		0.899
Constant	0.358	-3.783***
	(0.272)	(0.086)
	0.188	0.000
Observations	1,080	1,080
R-squared	0.013	0.192
Product Effect	NO	Yes
Country Effect	NO	Yes
Time/Month Effect	NO	Yes
Adj. R-squared	0.0113	0.178
F-test	6.658	138.8
Prob> F	0.001	0.000

*Source: Researcher's Computation, underlying data from National Bureau of Statistics (NBS), Lagos, Nigeria, National Institute of Statistics and Economic and Demographic Studies, Lome, Togo and the National Institute of Statistics and Economic Analysis, Cotonou, Benin, 2018. The dependent variable I absolute price dispersion. logDistance = log of the shortest distance between the two countries (from Google maps) used as proxy for transaction cost. Border = dummy variable that explains the border effect (1 if countries i and j are separated by a national border and 0 otherwise). NG_RepBen = dummy controlling for Nigeria and Republic of Benin Country-pair. Jan =dummy representing month of January effect. Dec =dummy representing month of December effect. Standard error (Robust that takes care of heteroscedaticity) in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

5.7 Quantile Regression

Contrasting the least square regression estimated in the preceding section, quantile regression is concerned with predicting the median rather than the mean and this has made the approach to be more robust to outlier than the traditional OLS. Generally, the result as presented in Table 4.6 shows that the border effect is more obvious in both the columns 1 and 2 of the Table and the effect of distance became more pronounced in the second column. These results are largely consistent with the result obtained under the least square approach and it confirmed the appropriateness of the least square model.

Table 6: Quantile Regression

VARIABLES	(1) Model	(2) Model
logDistance	0.638 (0.947) 0.500	1.091*** (0.019) 0.000
Border	0.791*** (0.139) 0.000	1.982*** (0.291) 0.000
Jan		-0.042 (0.033) 0.201
Dec		0.0128 (0.33) 0.696
Constant	0.140 (0.139) 0.828	-5.523*** (0.118) 0.000
Observations	1,080	1,080
Pseudo R-squared	0.001	0.273
Product Effect	NO	Yes
Country Effect	NO	Yes
Time/Month Effect	NO	Yes

Source: Researcher's Computation, underlying data from National Bureau of Statistics (NBS), Lagos, Nigeria, National Institute of Statistics and Economic and Demographic Studies, Lome, Togo and the National Institute of Statistics and Economic Analysis, Cotonou, Benin, 2018. The dependent variable I absolute price dispersion. logDistance = log of the shortest distance between the two countries (from Google maps) used as proxy for transaction cost. Border = dummy variable that explains the border effect (1 if countries i and j are separated by a national border

*and 0 otherwise). NG_RepBen = dummy controlling for Nigeria and Republic of Benin Country-pair. Jan =dummy representing month of January effect. Dec =dummy representing month of December effect. Standard error in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

5.8 Robust Regression

Similar to the quintile regression, the robust regression in Table 4.7 attempts to correct the outlier insensitivity in least square regression and this has made it another approach to be considered in this study of robustness check. Generally, the result is consistent with previous results. Specifically, the result shows that the effects of distance and border are significant and the magnitudes are more evident. These also confirmed the appropriateness of the least square model earlier estimated.

Table 7: Robust Regression

VARIABLES	(1) Model	(2) Model
LogDistance	**0.104** **(0.436)** **0.017**	**1.099***** **(0.367)** **0.003**
Border	**0.234***** **(0.639)** **0.000**	**2.209***** **(0.574)** **0.000**
Jan		**-0.016** **(-0.085)** **0.848**
Dec		**-0.006** **(0.851)** **0.942**
Constant	**0.319** **(0.298)** **0.284**	**-5.545**** **(2.481)** **0.026**
Observations	**1,080**	**1,080**
Product Effect	**NO**	**Yes**
Country Effect	**NO**	**Yes**
Time/Month Effect	**NO**	**Yes**
F-test	**6.74**	**49.47**
Prob> F	**0.001**	**0.00**

Source: Researcher's Computation, underlying data from National Bureau of Statistics (NBS), Lagos, Nigeria, National Institute of Statistics and Economic and Demographic Studies, Lome, Togo and the National Institute of Statistics and Economic Analysis, Cotonou, Benin, 2018. The dependent variable I absolute price dispersion. logDistance = log of the shortest distance between the two countries (from Google maps) used as proxy for transaction cost. Border = dummy variable that explains the border effect (1 if countries i and j are separated by a national border and 0 otherwise). NG_RepBen = dummy controlling for Nigeria and Republic of Benin Country-pair. Jan =dummy representing month of January effect. Dec =dummy representing month of December effect. Standard error in parentheses. *** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

Our results provide some evidence in support of the hypothesis of limited product market integration within West Africa sub-region. In all the years considered, from 2011 to 2015 relative price dispersion within country is less than price dispersion between countries. The average price dispersion within Nigeria is 0.0534 as against 0.4182 between Nigeria and Togo, 0.4841 between Nigeria and Republic of Benin and 0.4923 between Benin and Togo.

Both the distance and border dummy exert positive and significant impact on price dispersion. The distance of about 100km causes about 9.9percent deviation from LOP. Similarly, the presence of border causes about 0.22units of price differences between countries. The effects of distance becomes more significant as the magnitudes of border and distance increased after controlling for product, time and country pair fixed effects. On the other hand, seasonal impact of January and December are insignificant even though the prices of the commodities usually change more in the two periods compared to other months.

The results of the study compare favorably with results from other studies. The Nigerian-Benin border effect (0.220) is slightly higher than the Lesotho - South African border effect (0.208) (Nchake, 2013) indicating more cumbersomeness in the Nigerian Benin border. The distance effect is also greater in Nigeria – Benin (0.047) than Lesotho – South Africa (0.024) (Nchake, 2013), but less than for the South African Development Community (0.107) (Balchin, 2015). International comparison of price dispersion shows South Africa – Lesotho (0.390) (Nchake, 2013), Botswana – Lesotho (0.531), (Nchake,2013), EAC (0.443) (Versailles, 2012), South Africa – Botswana (0.431) compare favorably with Nigeria – Togo (0.418), Nigeria – Benin (0.484) and Benin – Togo (0.492). The result also indicates that distance has a positive and significant relationship with distance in the ECOWAS.

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