**Luqman O. Afolabi[1], Nor Aznin Abu Bakar[2], Mukhriz Izraf Azman Aziz[3]**

## OPENNESS AND ECOWAS REGIONAL TRADE: A PANEL COINTEGRATION ANALYSIS USING A GRAVITY MODEL

***This paper investigates the general effect of ECOWAS regional integration agreements on trade among its members, as well as the level of openness across ECOWAS. The panel dataset consists of bilateral flows of export from 15 ECOWAS countries for the period of 1983–2013, the cointegration method was used for estimation under the gravity model. Comparing the results, a negative and significant coefficient was discovered for the ECOWAS dummy variable, trade openness and financial openness, under pool ordinary least squares (POLS) estimators. Under dynamic ordinary least squares methods the coefficient of the ECOWAS dummy variable remained positive, but not significant. Trade openness was negative and significant under DOLS, while the variable remained positive and not significant under DLSDV. The financial openness variable was both negatively and positively insignificant under both. The empirical evidence indicates that there is a long term relationship inside ECOWAS, and thus, the level of openness among members impedes the level of trade flows on integration. However, the results reveal the fundamental significance of appropriate accounting for endogeneity when assessing trade policies.***

***Keywords:*** *ECOWAS; panel cointegration; regional integration; bilateral trade.*

**Лукман О. Афолабі, Нур Азнін Абу Бакар, Мухріз Ізраф Азман Азіз**

## ВІДКРИТІСТЬ РЕГІОНАЛЬНОЇ ТОРГІВЛІ В ЕКОВАС: ПАНЕЛЬНА КОІНТЕГРАЦІЯ ТА ГРАВІТАЦІЙНА МОДЕЛЬ

***У статті досліджено вплив регіональної інтеграції в межах ЕКОВАС на торговельні потоки між членами даної спільноти. Панельні дані описують двосторонні експортні потоки між 15 країнами – членами ЕКОВАС протягом 1983–2013 років. Для аналізу використано метод коінтеграції даних та гравітаційну модель. За допомогою методу найменших квадрантів також проаналізовано відкритість торгівлі та фінансів у даній регіональній спільноті. У цілому, емпіричні дані свідчать про наявність довготермінового взаємозв'язку між членами ЕКОВАС, при цьому відкритість відносин між ними впливає на обсяги торговельних потоків. В той же час при оцінювання торгових політик даних країн варто брати до уваги суттєвий фактор впливу однорідності, що в даному дослідженні відображено через наявність спільної мови та спільного кордону.***

***Ключові слова:*** *ЕКОВАС; панельна коінтеграція; регіональна інтеграція; двостороння торгівля.*

***Форм. 5. Табл. 3. Літ. 41.***

**Лукман О. Афолаби, Нур Азнин Абу Бакар, Мухриз Израф Азман Азиз**

## ОТКРЫТОСТЬ РЕГИОНАЛЬНОЙ ТОРГОВЛИ В ЭКОВАС: ПАНЕЛЬНАЯ КОИНТЕГРАЦИЯ И ГРАВИТАЦИОННАЯ МОДЕЛЬ

***В статье исследовано влияние региональной интеграции в рамках ЭКОВАС на торговые потоки между членами данного сообщества. Панельные данные описывают двусторонние экспортные потоки между 15 странами – членами ЭКОВАС в течение 1983–2013 годов. Для анализа использован метод коинтеграции данных и гравитационная модель. При помощи метода наименьших квадрантов также проанализированы открытость торговли и финансов в данном региональном сообществе. В целом, эмпирические данные свидетельствуют о присутствии долгосрочной взаимосвязи между членами ЭКОВАС, при этом открытость отношений между ними влияет на объёмы торговых пото-***

[1] Correspondence; University Utara Malaysia, Sintok, Kedah, Malaysia.
[2] University Utara Malaysia, Sintok, Kedah, Malaysia.
[3] University Utara Malaysia, Sintok, Kedah, Malaysia.

***ков. В то же время при оценке торговых политик данных стран стоит брать во внимание существенно влияющий фактор однородности, выражающийся в данном исследовании через наличие общего языка и совместной границы.***
***Ключевые слова:*** *ЭКОВАС; панельная коинтеграция; региональная интеграция; двусторонняя торговля.*

**Introduction.** The current state of the world assumes that non-discrimination principles establish explicit trading systems which are multilateral, and virtually all members of the World Trade Organization (WTO) have engaged in at least one regional integration agreement. Rapid increase of regional trade integration prompted many researchers to investigate the related trade effects. Since the 1990s, regional trade agreements were launched, while some remain under negotiation. The trade report has shown that, as of January, 2015, approximately 604 notifications of regional trade agreements have been scheduled to be executed, while 398 were in force (WTO, 2015). Regional level trade has been comprehensively assessed using the gravity model framework of international trade (Sapir, 2001). Regional trade has become the subject for discussion for both non-academicians and academicians so as to justify its existence.

ECOWAS was founded in 1975 by the ECOWAS treaty. Its members are Gambia, Ghana, Burkina Faso, Cape Verde, Liberia, Guinea, Senegal, Togo, Nigeria, Niger, Guinea Bissau, Mali, Benin, Cote d'Ivoire and Sierra Leone (ECOWAS, 2012). The population of the ECOWAS zone is around 300 mln, with the GDP of approximately 316 bln USD; the region represents about 4.5% of the world populace, but only 0.5% of the global GDP. Studies on ECOWAS regional integration are subtle, hence, few available ones either discover a positive effect or no effect of ECOWAS regional integration. The mixed empirical findings might be due to some factors such as the countries selected or the period chosen for the study.

The primary objective of evaluating regional trade integration is to ascertain whether the multilateral trading system is contradictory or complementary; in other words, this is another way to confirm Bhagwati's (1993) who tagged RIAs as "stumbling blocks" or "building blocks". Regional trade integration is regarded as one of the essential determinants of bilateral trade ties. The aim of this article is to examine the impact of ECOWAS trade flows, and also to ascertain the level of openness to trade among its members during 1983–2013.

**This paper aims** to contribute to the existing body of literature in two ways. Firstly, it aims to check the general effect of ECOWAS regional integration agreements on trade flows among its members and also to determine the level of openness.

Secondly, using panel cointegration, dynamic ordinary least squares and DLSDV for the selected data provide more robust results. For this purpose, this article introduces a dummy variable that is intended to serve as a proxy to check whether the ECOWAS trade agreement increases trade among members, or whether there is an element of diversion. In this regard, newly developed techniques are employed apart from POLS, which rely on panel cointegration exploration.

**Literature review.** The gravity model came to light as one the analytical tools in international trade studies, initiated by J. Tinbergen (1962) and P. Poyhonen (1963). This model was further improved by N.D. Aitken (1973), J.E. Anderson and E. van

Wincoop (2003), J.H. Bergstrand (1985), A. Deardorff (1998), H. Linnemann (1966).

However, RIAs' underlying theories were derived from Jacob Viner's Customs Union Issue (1950). The theory introduced two concepts, namely, trade diversion and trade creation, which serve as proxies to measure the welfare of regional integration. This was also used by numerous researchers, such as K.W. Dam (1963), C.A. Cooper and B.F. Massel (1965) and R.G. Lipsey (1960). Studies on non-member and member countries trade effect of RIAs include: K. Bagwell and R.W. Staiger (1998), R. Baldwin (1993), G.M. Grossman and E. Helpman (1995), P. Krishna (1998), P.I. Levy (1994).

These studies were focused mainly on evaluating the compatibility proliferation trend in RIAs formation under WTO-governed, multilateral trading systems. Furthermore, gravity models are grounded based on macroeconomic principles, trade theories, and the new economic geography.

In general, all of these theories are used to explain the existence of trade in different forms. Some theories lead to the development of similar gravity models. A theory used to assess trade flow at international levels has been developed by S.J. Evenett and W. Keller (1998) and J.E. Anderson and E. van Wincoop (2003). According to A. Deadorff (1998), the gravity model can be used for different types of business. It can also accommodate Heckscher-Ohlin trade, which can be affected by friction or otherwise.

However, based on the importance of international trade, determinants of trade flow between members need to be examined. In this regard, this article uses the gravity model, which was grounded based on the Newton's law, in order to assess international trade flows and their impact. Numerous studies have shown that gravity model is a successful tool in evaluating the effects of regional trade integration.

**Methodology and data.** The new trade theory was developed by E. Helpman and P.R. Krugman (1985). This theory serves as the basis for return to factor proportion principles. It is also regarded to as the Heckscher-Ohlin model (Heckscher, 1919; Ohlin, 1933). Generally, this theory provides an indepth explanation for trade patterns in relation to relative factor abundance. Explicitly, countries with abundant capital that is specialized in producing goods of absolute advantage tend to export goods that are capital intensive in nature, and then import those which are intensive. The reverse holds for labor, ample nations.

Furthermore, S.B. Linder (1961) proposed a demand-based theory to explain the similarity in terms of trade demand features between trading partners. Aggregating goods preference by importing goods from country *j* is related to the patterns of consumption in exporting country *j*. Thus, country *j* tends to develop industries related to its demand. Exchange of particular goods between countries greatly depends on continuous production, and demand for related and differentiated goods. Combining demand and supply of trade theories within the Heckscher-Ohlin and Chamberlin Linder frameworks, GDP and GDP per capita were identified based on their separate roles as in (Bergstrand, 1989).

Moreover, W.H. Gruber and R. Vernon (1970) improved more the Linder's hypothesis by adding the differences of per capita incomes among two or more countries in absolute terms into the gravity equation in order to capture the likely consumption pattern differences.

If a negative coefficient is discovered, it shows that trade of both countries is positively related, and also that the pattern of consumption and per capita incomes are linked, which is in line with the Linder hypothesis. Any positive coefficient supports proportions under the theory of trade.

E. Helpman and P.R. Krugman (1985), using the data of trade among industrialized nations, discovered that these nations can be explained better by their similarities instead of factor endowments differences. E. Helpman (1987) postulates the share of intra-industry trade that serves as the total value of partners involved in trade as a proxy to determine the relative country size and factor endowments that are in relative terms. In summary, Equation (1) adapts the cross-section specification using panel settings indicated by E. Helpman (1987). The specification of triple index for the gravity model was proposed by L. Matyas (1997) to serve as control variable represented by a dummy.

This effect is country-specific for the countries under export, as well as the importing country and the common shocks that are likely to occur affecting all the countries in the region. Some factors were highlighted by (Hummels and Levinsohn, 1995) as unique among countries, and which might also vary depending on the countries involved. It includes: cultural ties, border trade, trade restrictions of individual countries and seasonal trade, which can all be incorporated into the gravity model as country specific pair effects. Combining all particular effects into one was tested by (Egger and Pfaffermayr, 2003).

However, despite the tremendous increase of studies on panel unit root testing and cointegration gravity model, variables were largely ignored. For the purpose of this study, the methods of K.S. Im et al. (2003) and P. Pedroni (1999) are used to check whether the variables are non-stationary, and also to test further whether they are cointegrated. Several approaches can be used to estimate the long-run relationship between variables. C. Kao and M.-H. Chiang (2000) indicated that fixed effect estimator is always asymptotically normal, but it remains asymptotically biased. Although they suggested some correction for this bias, this does not perform very well, especially in reducing the bias with the small samples. Some authors recommended the following alternative methods of estimation, including cointegration.

P. Pederoni (1999) recommends fully modified ordinary least squares (FMOLS), whereas C. Kao and M.-H. Chiang (2000) proposed dynamic ordinary least squares (DOLS). FMOLS corrects for serial correlation and endogeneity present in OLS estimator.

In the same way, DOLS also deals with variables' endogeneity, and the likely presence of serial correlation through inclusion of lags and leads, or taking differencing of variables.

C. Kao and M.-H. Chiang (2000) indicated that both estimators have almost identical normal properties, although DOLS and FMOLS perform differently. It was discovered that FMOLS does not improve FE estimator properties when using finite samples, thus, B.H. Baltagi and C. Kao (2000) regarded DOLS to be the most efficient among panel cointegration estimation techniques.

In order to specify the gravity model in a cross-sectional manner, DSLDV, DOLS, and POLS specifications explicitly comprise time-invariant variables. Thus,

the specification of the gravity model of bilateral export can be stated as follows:

$$EXPORT_{ij}^{t} = \beta_i + C_j + \theta^t + \beta c_{ij} + \alpha_1 TOTALGDP_{ij}^{t} + \alpha_2 SIMGDP_{ij}^{t} + \alpha_3 DIFFGDPPC_{ij}^{t} +$$
$$\alpha_4 ECOWAS_{ij}^{t} + \alpha_5 TRADEOPENNESS_{ij}^{t} + \alpha_6 FINANCIALOPENNESS_{ij}^{t} + \mu_{ij}^{t},$$

where $EXPORT_{ij}^{t}$ represents the export flows within 15 ECOWAS countries, which was denoted using USD at constant 2000 prices. The ECOWAS dummy is denoted by 1 when both countries become ECOWAS members, otherwise it is denoted as 0, thus, this variable captures the trade effect of the 1993accession treaty. The similarity index can be calculated by the size of each country pair, using the following formula:

$$SIMGDP_{ij}^{t} = \log\{1 - [GDP_i^t / (GDP_i^t + GDP_j^t)]^2 + [GDP_j^t / (GDP_i^t + GDP_j^t)]\}. \quad (2)$$

Relative factor endowments can be captured with GDP per capita by taking the absolute differences that are also in log form, given as:

$$DIFFGDGPPC_{ij}^{t} = (\ln GDPPC_i^t - \ln GDPPC_j^t). \quad (3)$$

The total GDP is the addition of GDP of both countries taken into log form, and can be written as:

$$TOTALGDP_{ij}^{t} = (GDP_i^t + GDP_j^t). \quad (4)$$

In order to incorporate other components of the gravity model to this study, the theory specified variables must be included, formulated as:

$$EXPORT_{ij}^{t} = \beta_i + \alpha_1 TOTALGDP_{ij}^{t} + \alpha_2 SIMGDP_{ij}^{t} + \alpha_3 DIFFGDGPPC_{ij}^{t} +$$
$$\alpha_4 DISTANCE_{ij}^{t} + \alpha_5 LANGUAGE_{ij}^{t} + \alpha_6 ECOWAS_{ij}^{t} + \alpha_7 TRADEOPENNESS_{ij}^{t} + \quad (5)$$
$$\alpha_8 FINANCIALOPENNESS_{ij}^{t} + \alpha_9 COTING_{ij}^{t} + \mu_{ij}^{t}.$$

Trade openness can be measured by import plus export divided by GDP, as an index to measure the level of country's openness to trade. Financial openness was constructed mainly from binary dummy variables used to categorize the tabulation of restrictions on cross-border financial transactions which were stated in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).

The $DISTANCE_{ij}^{t}$ was measured using kilometers between the capital cities of all exporting countries within ECOWAS. $LANGUAGE_{ij}^{t}$ represents the historical linkage and cultural background between partners. Contig represents sharing a border, taken for all non-dummy variables.

Once again, the countries under study are: Gambia, Ghana, Burkina Faso, Cape Verde, Liberia, Guinea, Senegal, Togo, Nigeria, Niger, Guinea Bissau, Mali, Benin, Cote d'Ivoire and Sierra Leone. The period of study is 1983–2013. Bilateral exports of 15 countries were used for panel estimation with 6510 observation (15 x 14 x 31).

The data were sourced from the following sources: 1) export flows between ECOWAS countries (in USD), downloaded from International Monetary Fund's (2014), specifically under Direction of Trade Statistics, denoted using US producer prices 2000 = 100; 2) per capita GDP and GDP, in which the variables were sourced

from World Bank Indicators Database, reported in USD; 3) time-invariant variables, which included distance and language, downloaded from CEPII.

**Ampirical analysis.** Based on panel unit root and panel cointegration tests, gravity model variables wer tested using panel unit root in order to determine the stationarity level before estimating the model. Panel unit roots are of different types; panel unit root testing differs from the time series approach based on the stationarity or non-stationarity property of the null hypothesis. Panel variants primarily depend on data that is balanced or unbalanced, and whether cross-sectional dependence and heterogeneity are allowed or not.

Table 1 shows the unit root test conducted using Im et al.'s (2003) theory. The results show that all the variables are integrated at first difference I(1).

*Table 1.* **Panel unit root result,** *authors'*

| | Level | | | | First differences | |
|---|---|---|---|---|---|---|
| Regressors | Constant | No of obs. | Trend & Constant | No of obs. | Constant | No of obs. |
| Total GDP | 41.13 | 6090 | 21.20 | 6090 | -26.54*** | 5880 |
| GDP Similarity | -19.75 | 6090 | -4.74 | 6090 | -34.92*** | 5880 |
| GDPPC | -13.99 | 6090 | -20.46 | 6090 | -54.41*** | 5880 |
| Exports | 66.36 | 6090 | 5.77 | 6090 | -21.98*** | 5880 |
| Kopen | -46.77 | 6090 | 46.93 | 6090 | -76.16*** | 5880 |
| Topen | 16.92 | 6090 | 6.34* | 6090 | -45.84*** | 5880 |

*Note*: Null hypothesis testing for a unit root against the alternative in order to test the stationary of a series are computed using t-statistics (Im et al., 2003). Bayesian information criteria (BIC) are chosen as the optimal lag in most of the cases. *** is the significant level of 1%.

Cointegration test using Pedroni's (1999) model are presented in Table 2. The panel statistics comprise augmented Dickey-Fuller ADF (1979) t-statistics. The variance ratio test is represented by panel V and panel P, after P.C. Phillips and P. Perron (1988).

*Table 2.* **Pedroni Panel cointegration test results**

| Equation | Panel V | Panel rho | Panel PP | Panel ADF | Group rho | Group PP | Group ADF |
|---|---|---|---|---|---|---|---|
| ECOWAS1a | -0.77 | -2.80** | -15.46*** | -4.39*** | -0.92 | -14.46*** | -3.44*** |
| ECOWAS1b | 0.86 | -2.76** | -15.33*** | -3.45*** | -0.59 | -13.41*** | -2.47** |

*Note*: The test was conducted using residuals from the panel cointegrating regression, null hypothesis test of no cointegration against the alternative that all series are stationary (Pedroni, 1999). ECOWAS1a permits heterogeneous intercepts; ECOWAS1b permits individual trends that have linear and intercepts. One lag length was specified as the maximum chosen by Schwarz info criteria. ***, ** represent significance levels at 1% and 5% respectively.

The cointegration test is based on group statistics, and permits the presence of heterogeneity, mainly on the coefficients, in the long run. It can also accommodate both individual trends and intercepts into the equation.

Table 3 presents the estimated result for a gravity model of ECOWAS determinants. DOLS and DLSDV estimators of cointegrating vectors take controls of likely endogeneity that might occur from the joint determination of exports and other variables. Concerning the parameters estimators, as shown in Table 3, the coefficient

signs accorded theoretical predictions. Total GDP and GDP similarity index are significant; the positive and significant sign of the coefficient total GDP, and GDP similarity indicate that relative and economic size is a paramount tool for trade. Many of the countries are similar economically, have close ties and important trade relations. The coefficients of total GDP and GDP similarity index are relatively small under POLS and DLSDV. In contrast, the total GDP and difference in per capita GDP only increased under DOLS, which is very common in the literature (Egger and Pfaffermayr, 2004). A comparison between POLS, DLSDV and DOLS show the importance of controlling heterogeneity bias. Considering the income per capita variable, the positive and significance coefficient recorded by all the estimates demonstrates that the development gaps between countries considered for estimates are the main factor affecting the exports flow.

*Table 3.* **Gravity model of export**

| Regressors | POLS | DOLS | DLSDV |
|---|---|---|---|
| Total GDP | .031*** (28.45) | 19.49*** (13.50) | .012***(9.17) |
| GDP similarity | .828*** (12.56) | .924*** (5.92) | .298***(3.15) |
| GDPPC | .955*** (16.70) | 1.180*** (7.33) | .064 (1.33) |
| Distance | -.003**** (-5.40) | -.729** ( -4.53) | |
| Language | .215** (2.39) | ..538** ( 2.39) | |
| ECOWAS | -.357*** (-3.15) | -.132 (-0.28) | .046 (0.478) |
| Trade openess | -.210*** (-4.29) | -.212* (-1.70) | .041 (1.07) |
| Financial openess | -.152* (-1,86) | .289 (0.60) | -.165 ** (-2.48) |
| Contig | 1.04*** (10.51) | .912** (3.34) | |
| RMSE | 2.64 | 2.41 | |

*Note*: Heteroskedasticity robustness is reported in parentheses using test statistics (White, 1980). DOLS are estimated using I(1) explanatory variables cointegrated and generated from a regression that involves two pre- and post-future values using first differences. Coefficients estimated under the first stage are substituted into equation (1), while the remaining parameters of the model are estimated as in (Bun and Klaassen, 2007). *, **, *** indicate significance at 10%, 5% and 1% respectively.

Distance has a negative sturdy effect on the volume of trade between 15 nations (ECOWAS). In other words, the greater is the distance between ECOWAS countries, the less they engage in trade. This result is in line with the classical gravity model results. An increase in distance between countries i to j by 1% will lead to a decrease in exports that can be on average 1.1%. The decrease is constant for all the estimates. The trade openness variable is negative and significant in almost all the estimates except DLSDV, which is positive but not significant. The implication of this negative trend means that the flow of goods within ECOWAS is hampered by the failure of some countries to embrace full liberalization in order to spur growth in the long run. It is worthy to note the financial openness of the countries within ECOWAS; the index was negative and significant in two out of the three estimates used. Financial openness of the countries tends to hamper the flow of goods within ECOWAS, and in the long run, it does not favor, nor promote the pro-liberal/free trade policies adopted by ECOWAS.

Contig represents sharing the same border within ECOWAS. Higher significant level of the variable (at 1%) indicates that countries sharing the same border within

ECOWAS tend to trade more, which will eventually increase the bilateral trade relations.

Moreover, the common language variable is positive and statistically significant, indicating that two or more countries that share a similar language that is official tend to increasingly stimulate mutual and this result is condidtent with (Kahouli and Maktouf, 2013). It is imperative to discuss and analyze the impact of regional grouping using the coefficient of Intra-ECOWAS, which is negative and significant in 1 of 3 estimates. There is export diversion, and the finding seems logical considering the small volume of trade within the members, since most of these countries' specialization and production are almost identical.

**Conclusion.** Using panel cointegration method in estimating the gravity model of international trade also safeguards us against the problem of spurious regression. The difference in the results indicated that a critical feature of gravity modelling is heterogeneity.

However, looking at the increasing number of RTAs over the years, especially starting from the mid-1990s, both trade flows and its effect have received considerable attention. The unexpected negative impact on trade under RTAs among member countries can be captured using dummy variables within the framework of the gravity model. The gravity model became well-known mainly because of the success it achieved empirically, including its simplicity and flexibility in explaining trade patterns. This article examined the impact of ECOWAS trade flow, and also invstigated the level of openness to trade among ECOWAS members in the period of 1983–2013. The spread of regional trade has generated much criticism over the years. One of the criticisms in some quarters is the fear of trade diversion by passing an effective non-member country toward a member country that less efficient, particularly in terms of production. Within the study area, there is untapped potential for export to some partners within member states.

Based on the empirical results, ECOWAS members should move towards better regional integration in order to increase trade promoting economic growth. Also, considering the level of openness both financial and trade, it is clear that some of the countries within ECOWAS have not embraced the liberalization fully. Therefore, restrictive polices need to be removed in order to improve trade performance.

The results also indicated that policy makers need to develop and encourage trade that will boost economic development. Empirical results may help regional governing bodies of ECOWAS identify the structural differences and react to market needs.

Another way ECOWAS performance can be improved is the development of robust policies concerning industrial production in order to improve and enhance the competitiveness capacity of all the members. Finally, it is very imperative for ECOWAS to move to another level of regional integration in order to enhance its overall performance.

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