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Intra-Industry trade and its effects on business cycle synchronization in ECOWAS: An empirical analysis

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Abstract

This article examines the impact of intra-industry trade on Business cycle synchronization in the Economic Community of West African States (ECOWAS). The paper has two primary contributions. First, it utilizes the two-digit level HS classification to measure intra-industry trade, which is easy to interpret and calculate and is suitable for countries with low trade intensity. Second, it employs the system generalized method of moments (system-GMM) to analyze the dynamic relationship between variables and address the issue of endogeneity. Using data from 13 countries between 2000 and 2020 enables the investigation of endogeneity in ECOWAS. Results from the system-GMM estimation indicate a significant and positive relationship between intra-industry trade intensity and business cycle synchronization, advocating for policies focused on reducing tariff barriers, enhancing financial integration, and diversifying production.

None
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1. Introduction

The Optimum Currency Area (OCA) theory advocates for the adoption of a single currency in ECOWAS by 2027, a move expected to bolster trade. The success of this common monetary policy hinges on the synchronization of business cycles, a pivotal criterion (Zouri 2020). Theoretical development on OCA, such as the endogeneity of the OCA criteria thesis (Frankel and Rose 1998), challenge the specialization theory (Krugman 1993), by suggesting a positive correlation between trade and business cycle synchronization (BCS). However, the specialization theory argues the opposite effect when specific shocks dominate.

The current international trade landscape is marked by reduced export and import volumes (WTO 2021). Nevertheless, the value of intra-ECOWAS trade has increased to 10.4% in 2019, a 3% rise from 1996, when it represented only 7.7% of the region's total external trade, (CEDEAO 2018). The low level of intra-regional trade raises questions about the role of intra-industry trade in the business cycle synchronization in ECOWAS. The main objective of this paper is to study the link between intra-industry trade and BCS within ECOWAS countries by considering the endogeneity hypothesis of Frankel and Rose (1998). Several other studies have analyzed the endogeneity, especially the effects of trade integration (Imbs 2004; Li 2017; Tapsoba 2009; Zouri 2020), specialization (Azcona 2019; Beck 2019; Cainelli, Lupi, and Tabasso 2021; Padhan and Prabheesh 2020) and financial integration (Antonakakis and Tondl 2014; Beck 2019; Gong and Kim 2018; Imbs 2004; Jos Jansen and Stokman 2014; Lee 2010; Mejía-Reyes et al. 2018) on BCS.

The majority of research on intra-industry trade focuses on European and Southeast Asian countries where intra-industry trade intensity is very high relative to developing countries and uses the harmonized system (HS) three- and four-digit classification (Duval et al. 2016; Imbs 2004; Jeon 2018; Li 2017; Rana, Cheng, and Chia 2012; Saiki and Kim 2014; Shrawan and Dubey 2021). The issue of econometric endogeneity in analyzing the relationship between intra-industry trade and business cycle synchronization stems from the bidirectional influence between these variables, where unobserved factors may simultaneously affect trade patterns and economic fluctuations, leading to biased estimates. Furthermore, the generalized method of moments (GMM) approach is employed to explore the determinants of business cycle synchronization (Nzimande and Ngalawa 2017). Traditional methods, such as fixed or random effects, introduce endogeneity concerns, while the 2SLS approach faces challenges related to collinearity, instrument selection, and result interpretation. These limitations hinder an accurate assessment of the effects of intra-industry trade on cyclical synchronization, potentially resulting in biased findings and misleading policy implications. Our research, therefore, contributes to literature in two significant ways. First, we analyze the intra-industry trade indicator based on the Harmonized System (HS) classification at the two-digit level for each pair of countries, providing a straightforward and interpretable measure particularly suitable for countries with low trade intensity. Second, we employ the generalized method of moments (system-GMM) with gravity variables as instruments, enabling a dynamic study of the relationship while effectively addressing the endogeneity issue.

The remainder of the research is presented as follows: The second section summarizes the literature review on trade and business cycle synchronization, while the third section presents the stylized facts. Methodology and data are described in the fourth section and the fifth section presents the results and the robustness tests. The last section concludes.

2. Brief literature review

The importance of intra-industry trade for the BCS has been widely studied both theoretically and empirically. Imbs (2004) attributes intra-industry trade as an important reason behind the considerable influence of trade integration on the BCS. Li (2017) applied random-effects panel regressions to demonstrate that intra-industry trade significantly and positively impacts BCS in Asia. Europe, specifically the Eurozone, is another region of interest in literature. Rana, Cheng, and Chia (2012) compared the relationship between BCS and intra-industry trade in Europe and Asia. They found that the effect of intra-industry trade is stronger and more decisive for East Asia than Europe. Saiki and Kim (2014) used Eurozone and Eastern Asia data to show that increased intra-industry trade positively impacts BCS. Jeon (2018) found a strong and positive effect of intra-industry trade on BCS using value-added trade data. These results are also supported by Duval *et al.* (2016) and Shrawan and Dubey (2021).

While previous research has mainly focused on developed countries, there is a growing body of work examining the relationship in developing countries. Calderon, Chong, and Stein (2007) show that trade integration's impact on developing countries' BCS is weaker and more ambiguous due to specialization, differences in production, and lower trade volumes. However, some researchers have found a positive and significant link between trade intensity and BCS for African countries (Tapsoba 2009), and Maghreb countries (Eggoh and Belhadj 2015). Zouri (2020), concludes that bilateral trade and financial openness are the main determinants of BCS in ECOWAS.

The literature has explored the impact of sectoral specialization on BCS. Padhan and Prabheesh (2020) find that sectoral specialization has a negative effect on BCS. Beck (2019) identifies sectoral specialization, intra-industry trade, and financial integration as significant determinants of BCS. Similarly, Cainelli, Lupi, and Tabasso (2021) show that sectoral specialization and trade are robust BCS determinants and spatially correlated determinants.

Literature lacks consensus on the relationship between financial integration and business cycle synchronization (BCS). Some scholars suggest that financial integration negatively affects BCS (Beck 2019; Gong and Kim 2018). Thus, foreign direct investment (FDI) is widely accepted as a proxy for capital flows that can effectively approximate financial integration.

Kalemli-Ozcan, Papaioannou, and Peydro (2013) find that the positive effect of financial integration on economic cycle synchronization is partly due to the use of cross-sectional data. However, their analysis, which accounts for time dynamics and financial contagion, shows that this effect is negative, aligning with predictions from international business cycle models. Antonakakis and Tondl (2014) also find a negative relationship between FDI and BCS, whereas Jos Jansen and Stokman (2014) establish a positive relationship, and Lee (2010) finds mixed results. Therefore, the relationship between FDI and BCS is ambiguous, especially as these studies do not control for model uncertainty and reverse causality. In contrast, Mejía-Reyes *et al.* (2018) find a significant and positive impact of FDI on BCS between Mexico and the United States.

Using a dynamic panel framework, Beck (2021) indicates that capital mobility positively impacts BCS in the European Union. (Nzimande and Ngalawa 2017) examine, using GMM estimator over the period 1994-2014, how trade integration, financial integration, fiscal policy convergence, monetary policy similarity, and oil prices influence BCS in the SADC region, revealing that while trade and policy coherence enhance synchronization, financial flows and oil prices negatively affect it, with important implications for the proposed SADC monetary union. (Beck and Nzimande 2023) analyze the impact of bilateral migration on BCS among South African countries seeking economic integration, using a Bayesian model

averaging approach that showed labor migration initially intensifies business cycles but ultimately leads to decreased synchronization and long-term divergence. Meanwhile, (Fankem and Mbesa 2023) investigate the potential for an African monetary union by analyzing BCS among five Regional Economic Communities (RECs) using a continuous wavelet approach, revealing heterogeneous synchronization patterns and insufficient levels of synchronization that indicate African countries are not fully benefiting from a common monetary policy. The literature does not have a consensus on the relationship between trade intensity and BCS, despite most researchers suggesting a positive link. The focus of the literature on Africa is on the intensity of total trade rather than intra-industry trade, making this paper's contribution significant.

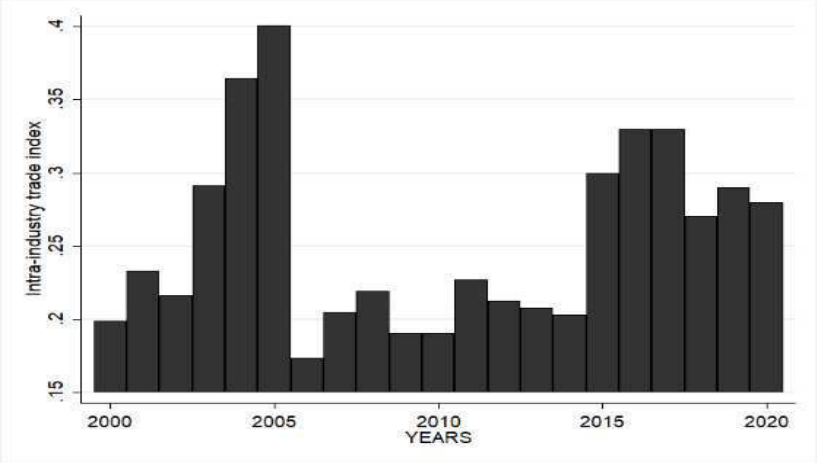
3. Stylized facts on trade intensity and BCS

The section presents firstly stylized facts on trade and secondly discusses the degree of correlation of business cycles.

3.1. Stylized facts on trade intensity

Figure 1 illustrates the evolution of intra-industry trade in ECOWAS between 2000 and 2020. The average level of intra-sector trade over the period, around 0.26, with unstable dynamics over the last two decades. From 2000 to 2005, the intra-industry trade index increased, while it decreased and experienced a period of stagnation between 2006 and 2014. In 2015, the intra-industry index increased, before decreasing between 2017 and 2019. This instability of the intra-industry trade index in ECOWAS suggests that the potential of regional integration is not being effectively used, and calls into question the mechanisms for successfully establishing a monetary union in the subregion.

Figure 1. Evolution of intra-industry trade in ECOWAS.



Source: Author based on UN COMTRADE data.

In recent years, ECOWAS has been marked by political, security, and health crises that have considerably impacted intra-industry trade and intraregional trade. With the low intraregional trade index in ECOWAS (around 10%), intra-community trade's weakness could significantly hinder monetary policy's effectiveness (Bikai and Afomongono 2017). The evolution of intra-industry trade is due to the limited development of industries, especially in manufacturing, and poor infrastructure in most economies. The evolution of trade is highly influenced by business cycle dynamics, which will be analyzed in the subsequent subsection.

3.2. Stylized facts on business cycle synchronization

In our research, we consider two countries *i* and *j*, and the cyclical economic components of the real GDP of both countries, obtained from trend-cycle decomposition technique. The linear correlation coefficient between the cyclical components measures the degree of cycles synchronization between both countries. A coefficient of 1 indicates perfect synchronization of the cycles of both countries, while a value of -1 indicates complete desynchronization. A correlation of zero suggests that the variables have no relationship. Table A1 in the appendices reports the bilateral correlations of the cyclical economic components of ECOWAS countries. The table shows that the business cycles of Benin and Senegal, Burkina Faso and The Gambia, and Cabo Verde and Nigeria have significant but low correlation (<0.5), suggesting weak synchronization. In contrast, Burkina Faso and Senegal have the most synchronized business cycles with a positive and significant correlation coefficient of 0.763. Burkina Faso is also in a similar cycle phase with Cape Verde and The Gambia. However, country pairs such as Burkina Faso and Côte d'Ivoire, and Cabo Verde and Côte d'Ivoire are in opposite cycle phases. Nigeria's business cycle is significantly correlated with ECOWAS (0.984). This strong correlation indicates the significant influence of Nigeria in the region, which accounts for more than 70% to the region's GDP. However, Guinea and Senegal seem strongly disconnected from the ECOWAS zone, with negative and significant correlation coefficients.

4. Methodology and data

This section proposes an empirical modeling of the relationship between trade and BCS and discusses the data and sources used for the estimates.

4.1. Empirical Modelling

The empirical specification is based on that of Imbs (2004), and is presented as follows:

$$\rho_{ijt} = \alpha + \beta trade_{ijt} + \varphi GL\_index_{ijt} + \gamma spec_{ijt} + \delta financial_{ijt} + \tau Z_{ijt} + \varepsilon_{ijt} \quad (1)$$

In the above equation, ρ_{ijt} is the correlation of the GDP cycle between countries *i* and *j* during a decade T. The GDP cyclical components are obtained from different filters: Hodrick-Prescott (HP), Baxter and King, Christiano-Fitzgerald, and Hamiton. Z_{ij} represents a set of gravity variables including common border (border), common language (*language*), distance between capitals in logarithm (*ldistance*), the population of country *i* in logarithm (*lpopi*) and that of country *j* (*lpopj*)); ε_{ijt} is the classical error term; α, β, φ, γ, δ, and τ are coefficients to be estimated. The expected sign of the main parameter β is positive.

Trade$_{ijt}$ is the trade intensity between *i* and *j* in period *t*. This indicator includes three trade intensity measures (*tindex1*, *tindex2*, and *tindex3*) and intra-industry trade (GL_index).

$$tindex1_{ijt} = \frac{1}{T}\sum_{t=1}^{T}\frac{X_{ijt} + M_{ijt}}{X_{it} + M_{it} + X_{jt} + M_{jt}}, \quad (2)$$

$$tindex2_{ijt} = \frac{1}{T}\sum_{t=1}^{T}\frac{X_{ijt} + M_{ijt}}{GDP_{it} + GDP_{jt}}, \quad (3)$$

$$tindex3_{ijt} = \frac{1}{T}\sum_{t=1}^{T}\frac{X_{ijt} + M_{ijt}}{GDP_{it}\left(1 - a_{it}\right) + GDP_{jt}\left(1 - a_{jt}\right)}, \quad (4)$$

where a_{it} and a_{jt} represent country i (j)'s shares in ECOWAS's GDP. Intra-industry trade intensity index (GL_index) is defined as follows:

$$GL\_index_{ijt} = \frac{1}{T}\sum_{t=1}^{T}\left[1 - \frac{\sum_{k}\left|X_{ijkt} - M_{ijkt}\right|}{\sum_{k}\left(X_{ijkt} + M_{ijkt}\right)}\right]. \quad (5)$$

$Spec_{ijt}$ represents the specialization index and is given by the following equation:

$$spec_{ijt} = \frac{1}{T}\sum_{t=1}^{T}\sum_{n=1}^{N}\left|S_{nit} - S_{njt}\right| \quad (6)$$

Snit is the share of sector n in the GDP of country *i* at time *t*. The sectoral decomposition is made according to the agriculture, industry and trade sectors. The variable "Spec" encompasses two components: "Spec_prod" representing specialization in production (agriculture and industry), and "Spec_trade" representing specialization in trade (goods and services). Finally, financial integration is approximated by foreign direct investment (FDI), and is defined as follows:

$$financial_{ijt} = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{FDI_{it}}{GDP_{it}} + \frac{FDI_{jt}}{GDP_{jt}}\right). \quad (7)$$

4.2. Filters used for trend-cycle decomposition

The Hodrick-Prescott filter is useful for isolating long-term trends in economic data, aiding in the identification of similarities and divergences in business cycles across regions or countries (Tapsoba 2009). However, it has faced criticism for removing long-term fluctuations exceeding eight years and for the uncertainty surrounding the choice of the smoothing parameter, which has varied between 100 (Hodrick and Prescott 1997) and 6.25 (Ravn and Uhlig 2002). The Baxter-King filter addresses some of these issues by incorporating both short- and long-term cycles in the cyclical component based on the researcher's specified period. The Christiano-Fitzgerald filter is a flexible approach for decomposing time series data that effectively isolates business cycle fluctuations by utilizing a band-pass filtering method, allowing for the identification of both short- and long-term cycles, while preserving important characteristics of the data. Lastly, the Hamilton filter offers a more flexible approach by using a moving average to extract cycles, making it adept at identifying turning points in economic time series (Hamilton 2020). Each of these filters provides unique advantages, allowing economists to understand underlying patterns in economic data better and to draw more accurate conclusions regarding business cycle dynamics.

4.3. Data and sources

The sample includes 13 ECOWAS countries,[1] resulting in 78 country pairs, over the period 2000-2020. The number of periods considered yields 936 observations per variable. Business cycle synchronization (BCS) is calculated using a 10-year rolling window correlation coefficient between two countries. All explanatory variables, including FDI, trade intensities, specialization, etc., are based on 10-year moving averages. Detailed data and sources can be found in Table A2 in the Appendices.

5. Estimation results and discussion

This section offers descriptive statistics of the variables used in the econometric model,

[1] Liberia and Guinea-Bissau are excluded from the sample, due to unavailability of data.

presents the outcomes of the econometric estimations and robustness tests.

5.1. Descriptive statistics

The statistics for the variables are presented in Table I. The cycle correlation obtained through the Hodrick-Prescott (HP) filter has a mean of -0.010 and a standard deviation of 0.427. The variables tindex1, tindex2, and tindex3 have respective means of 0.004, 0.002, and 0.002. Their respective standard deviations are 0.009, 0.004, and 0.005. The minimum and maximum values for tindex1, tindex2, and tindex3 are 0 and 0.067, 0.030, and 0.031, respectively. The main interest, the intra-industry trade indicator (GL index), has a mean of 0.052 and a standard deviation of 0.068. Its minimum value is 0, and its maximum value is 0.475.
The financial variable has a mean of 0.085 and a standard deviation of 0.043, with a minimum value of -0.009 and a maximum value of 0.218. This low average suggests poor financial integration within ECOWAS. The average level of Spec_prod and spec_trade is 0.199 and 0.294, respectively. This result highlights a specialization more oriented towards services than production in ECOWAS.

Table I. Descriptive statistics

Variables	Observations	Mean	Std. Deviation	Minimum	Maximum
BCS	936	-0.010	0.427	-0.960	0.878
tindex1	936	0.004	0.009	0	0.067
tindex2	936	0.002	0.004	0	0.030
tindex3	936	0.002	0.005	0	0.031
GL index	936	0.052	0.068	0	0.475
financial	936	0.085	0.043	-0.009	0.218
spec_prod	936	0.199	0.114	0.035	0.582
spec_trade	936	0.294	0.159	0.042	0.680

Source: Author

Table II indicates that the explanatory variables, namely tindex1, tindex2, tindex3, GL index, and spec_prod, are generally positively correlated with the dependent variable BCS. However, only the variables measuring trade intensity (tindex1, tindex2, and tindex3) are significantly and positively correlated with BCS. Once the variables have been described and the correlation matrix analyzed, an endogeneity test is necessary to determine the appropriate method.

Table II. Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) BCS	1							
(2) tindex1	0.076*	1						
(3) tindex2	0.099**	0.973***	1					
(4) tindex3	0.061	0.939***	0.948***	1				
(5) GL index	0.031	0.175***	0.157***	0.311***	1			
(6) financial	-0.002	-0.091**	-0.051	-0.103**	-0.232***	1		
(7) spec_prod	0.038	-0.224***	-0.208***	-0.253***	-0.181***	0.514***	1	
(8) spec_trade	-0.041	0.034	0.004	0.034	-0.121***	0.392***	0.025	1

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Author

5.2. Endogeneity issue

Table III displays the endogeneity tests conducted on the variables. These tests reveal the existence of an endogeneity issue, as anticipated by literature. To address this, we will utilize the GMM-system estimator in our study.

Table III. Endogeneity test results

Dependent Variable	Independent Variables	Statistics (Probability)
ρ or BCS	tindex1	25.040 (0.000)
	tindex2	18.542 (0.000)
	tindex3	22.933 (0.000)
	GL_index	25.948 (0.000)

Source: Author

Moreover, the literature highlights the advantages of employing the GMM estimator compared to other estimation techniques (Asongu and Odhiambo 2020). Firstly, the GMM estimator facilitates the identification of potential sources of endogeneity among explanatory variables by employing random variables as instruments, thereby addressing issues such as unobserved heterogeneity, omitted variables, and simultaneity in all regressors (Boateng et al. 2018). This approach also enables controlling for reverse causality by incorporating instruments while accounting for time-invariant omitted variables. Secondly, the GMM estimator allows for controlling cross-country variation in the regressions. Lastly, it corrects for biases associated with the difference estimator (Arellano and Bond 1991). The proper application of the GMM estimator requires ensuring instrument validity and avoiding an excessive number of instruments that may overload endogenous variables. Having justified the chosen model, the subsequent subsection will present the results and discussion.

5.3. Results and discussion

The estimated results are presented in Table IV. The system-GMM method was used for estimation, as previously mentioned. The instruments used in the regression are those commonly employed in the literature (Frankel and Rose 1998; Tapsoba 2009), and were selected using a stepwise method that combines various instruments. The significance of the instruments guides the selection process. The following gravity variables are used as instruments in our regressions: the border variable (equal 1 if two countries share the same border), the landlocked variable (equal 1 if at least one of the countries is landlocked), and colonizer variable (equal 1 if both countries have the same colonizer). The p-values of the Hansen statistic are all greater than 10%, implying the acceptance of the null hypothesis of instrument validity. Additionally, the literature on the determinants of business cycle synchronization often employs standardized coefficients (Frankel and Rose 1998; Calderon, Chong, and Stein 2007; Tapsoba 2009), which indicates that a one-standard-deviation (abbreviated as SD) increase in the trade intensity indicator results in an increase in synchronization.

In Table IV, we observe two groups of regressions using the trend-cycle decomposition technique of real GDP, which enables the calculation of the BCS using the HP filter. The first group, including regressions (1)-(4), considers production specialization (spec_prod), while the second group, comprising estimates (5)-(8), includes trade specialization (spec_trade). The regressions within each group differ according to the trade intensity indicator employed. All regressions include the financial integration variable (fin_int) to avoid the omitted variable bias.

Based on the data in Table IV, the coefficients on trade intensity are positive and significant for estimates (1)-(3), with estimated standardized coefficients of 0.105 for tindex1, 0.185 for tindex2, and 0.270 for tindex3. A one SD increase in tindex1 (respectively, tindex2 and tindex3) induces a 0.105 point (0.185 and 0.270 point, respectively) increase in BCS. For estimation (4), the normalized coefficient of the GL index is 1.535, indicating a stronger intensity than that obtained in estimates (1)-(3). The coefficient of the financial integration variable (fin_int) is positive and significant in estimate (1) and negative and insignificant in estimates (2)-(4).

When considering estimates (5)-(8) in Table IV, the coefficients associated with trade intensity indicators are all positive and statistically significant. The significance levels are 10% for estimates (5), (6), and (8), and 5% for estimate (7). An increase of one standard deviation in tindex1 (respectively tindex2 and tindex3) is associated with an increase of 0.344 point (respectively 0.046 and 0.428 point) in the BCS. The normalized coefficient of the GL index is 1.545 points, which is higher than the other intensities estimated in estimates (5)-(7). The coefficients of the trade specialization variable (Spec_trade) are positive and significant in all estimates except for estimate (8).

Table IV shows that the coefficients affected by financial integration are positive and significant in estimates (1) and (6) and negative and significant in estimates (8), leading to a mitigated conclusion concerning the sign of the financial integration coefficient.

The estimation results suggest a significant and positive effect of trade intensity, specifically intra-industry trade, on the business cycle synchronization (BCS) of ECOWAS countries. These findings confirm the endogeneity of OCA in the literature (Calderon, Chong, and Stein 2007; Tapsoba 2009; Zouri 2020) and demonstrate that trade is an essential determinant of business cycle synchronization in the region. The results indicate that increased productivity in the countries results in higher production and income, leading to increased imports of intermediate and finished goods from the trading partner. This, in turn, should boost the output and income of the trading partners. Our results are consistent with the findings of Imbs (2004), who suggests that trade integration fosters spillover effects, leading to more excellent synchronization of countries' business cycles.

Above all, our findings confirm the previous findings obtained for ECOWAS in the study of Zouri (2020). This result could be linked to macroeconomic convergence criteria that impose rigorous management at the member state level. This positive relationship persists despite the differences in production structures. Tapsoba (2009) has highlighted that African countries are highly specialized. Our results do not provide conclusive evidence regarding the nature of the relationship between financial integration and BCS, as well as the relationship between specialization and BCS. Our findings, however, validate the relevance of OCAs in the context of the ECOWAS zone. Robustness tests will be conducted in the next section to support these findings.

Table IV. Estimation results (trade and BCS)

Variables	(1) BCS	(2) BCS	(3) BCS	(4) BCS	(5) BCS	(6) BCS	(7) BCS	(8) BCS
L.BCS	0.951***	-0.047	-0.261	0.215	-0.142	0.289	-0.021	-0.160
	(0.104)	(0.141)	(0.559)	(0.188)	(0.166)	(0.207)	(0.141)	(0.501)
financial	10.127*	-0.762	-0.108	-24.499	0.448	15.369*	-1.701	-69.692*
	(5.842)	(1.160)	(2.547)	(16.657)	(2.523)	(8.393)	(1.425)	(35.486)
border	-0.974**	-2.557**	-19.241*	0.019	0.914	-0.571	1.034	-5.354*
	(0.435)	(1.194)	(10.440)	(0.751)	(0.753)	(0.543)	(0.660)	(3.144)
language	-0.112	-0.060	2.261	-0.672	-0.175	1.055	-0.360*	-7.533*
	(0.103)	(0.408)	(1.989)	(0.950)	(0.273)	(0.681)	(0.207)	(3.888)
ldistance	-0.162**	-2.148*	-17.895*	0.289	1.069	-0.425	1.126*	1.025
	(0.064)	(1.086)	(10.016)	(0.368)	(0.800)	(0.449)	(0.614)	(1.380)
lpopi	0.207*	1.154	-0.437	1.545	0.470	-2.104	0.959**	13.768**
	(0.119)	(0.721)	(1.294)	(2.433)	(0.555)	(1.425)	(0.419)	(6.887)
lpopj	3.260**	-0.058	4.003	1.114	0.468	5.061**	-0.292	-14.130**
	(1.447)	(0.508)	(2.667)	(1.195)	(0.954)	(2.501)	(0.423)	(6.422)
tindex1	28.037*				48.606*			
	(15.495)				(25.289)			
	[0.105]				[0.344]			
tindex2		73.260**				69.548*		
		(29.913)				(37.491)		
		[0.185]				[0.046]		
tindex3			88.834**				62.300**	
			(39.081)				(29.346)	
			[0.270]				[0.428]	
GL_index				19.486**				25.338*
				(9.431)				(14.270)
				[1.535]				[1.545]
spec_prod	-3.861	-5.593*	-20.669*	15.564**				

	(2.873)	(2.975)	(10.837)	(7.190)				
spec_trade					2.394**	2.692**	3.004***	-58.745
					(1.019)	(1.205)	(1.036)	(37.964)
Constant	-23.402**	9.283	108.449*	-22.389	-15.194*	-21.116**	-13.421***	24.443
	(10.775)	(6.710)	(64.940)	(23.324)	(8.920)	(9.498)	(4.922)	(33.112)
AR(1)	-1.88	1.670	1.720	1.930	1.810	1.890	1.700	1.660
	(0.061)	(0.096)	(0.086)	(0.053)	(0.070)	(0.059)	(0.090)	(0.097)
AR(2)	-1.500	-1.580	1.340	1.630	1.320	-1.470	-1.490	1.530
	(0.133)	(0.115)	(0.180)	(0.104)	(0.187)	(0.142)	(0.135)	(0.127)
Sargan/Hansen	10.970	17.580	3.540	1.500	9.110	7.260	10.170	3.280
	(0.204)	(0.415)	(0.896)	(0.472)	(0.105)	(0.701)	(0.857)	(0.512)
Observations	858	858	858	858	858	858	858	858
Number of id.	78	78	78	78	78	78	78	78

Notes: Standard errors in parenthesis; Standardized coefficients in square brackets; *** p<0.01; ** p<0.05; * p<0.1.
Source: Author

5.4. Robustness check

Robustness tests are conducted on the model, focusing on the dependent variable (BCS) and estimation technique. The first test uses a different trend-cycle decomposition technique of real GDP, namely the linear decomposition technique based on GMM estimator. Additionally, a 2SLS regression are employed. Table V presents the results of the robustness checks on the estimates obtained by changing the dependent variable and estimation technique. Only the coefficients of the variables of interest (trade and GL index) are reported to save space. The coefficients of the other variables can be provided to the authors upon request. When accounting for specialization (trade), all coefficients assigned to trade intensities, including tindex1, tindex2, tindex3, and GL index, are positive and significant, suggesting that increase trade across ECOWAS countries led to more synchronized business cycle and validating the endogeneity hypothesis of OCAs. These results confirm the previous findings and demonstrate their robustness across different estimation techniques such as GMM and 2SLS. The use of the 2SLS method yields positive and significant coefficients for trade.

Table V. Robustness check results: estimation technique

		GMM (linear decomposition)		2SLS	
		Specialization (production)	Specialization (trade)	Specialization (production)	Specialization (trade)
Tindex1	Coefficient	43.168** (20.479)	33.375** (16.355)	28.950** (14.306)	13.808* (7.693)
	AR(1)	2.350 (0.019)	1.920 (0.055)		
	AR(2)	-1.360 (0.173)	-1.510 (0.131)		
	Sargan/Hansen	21.50 (0.310)	18.95 (0.272)		
Tindex2	Coefficient	41.839* (22.472)	62.862* (34.745)	59.061** (29.422)	32.229* (17.577)
	AR(1)	2.570 (0.010)	1.680 (0.000)		
	AR(2)	-1.300 (0.195)	-1.590 (0.112)		
	Sargan/Hansen	20.000 (0.274)	22.580 (0.125)		
Tindex3	Coefficient	31.964* (18.768)	78.405* (40.954)	53.509* (30.735)	28.874*** (14.916)
	AR(1)	1.890 (0.059)	1.810 (0.000)		
	AR(2)	-1.440 (0.150)	-1.460 (0.145)		
	Sargan/Hansen	19.77 (0.101)	17.67 (0.410)		
GL_index	Coefficient	34.792* (20.552)	3.893** (1.480)	2.703* (0.657)	1.290** (0.587)
	AR(1)	1.710 (0.087)	2.030 (0.042)		
	AR(2)	1.530 (0.127)	0.400 (0.692)		
	Sargan/Hansen	2.400 (0.122)	7.130 (0.129)		

Notes: Standard errors in parenthesis. ***, ** and *: significant at the respective threshold of 1%, 5% and 10%.
Source: Author

Furthermore, we use other filters, such as Baxter and King (1999), Christiano-Fitzgerald (2001), and Hamiton (2017), to check for the robustness of our results. Table VI contains the estimation results that confirm our previous findings. The coefficients assigned to the trade indicators are all positive and significant regardless of the filter used. Moreover, the coefficients assigned to the GL_index are also positive and significant at the 5% level in estimations (1) and (3), and at the 10% level in estimations (2), (4)-(6). Then, intra-industry trade has a positive and significant impact on business cycle synchronization in ECOWAS countries.

The positive impact of intra-industry trade on business cycle synchronization among ECOWAS countries suggests significant implications for economic integration and future monetary union. As trade intensities increase, countries experience stronger economic ties, facilitating resource sharing and regional development. This synchronization means that while shocks may propagate more easily across borders, it also provides an opportunity for coordinated policy responses to mitigate adverse effects. Furthermore, the robustness of these findings highlights that deeper economic integration can lead to substantial gains from a common currency, such as reduced transaction costs, enhanced price stability, and aligned fiscal and monetary policies, ultimately contributing to greater regional resilience and economic prosperity.

Table VI: Robustness check: Change of filters

Filters	Baxter and King		Cristiano-Fitzgerald		Hamilton	
	(1)	(2)	(3)	(4)	(5)	(6)
Variable	BCS	BCS	BCS	BCS	BCS	BCS
L.BCS	0.902***	1.068***	-0.712**	1.067***	0.513**	0.406
	(0.180)	(0.119)	(0.278)	(0.119)	(0.207)	(0.382)
GL_index	8.285**	1.753*	14.684**	1.713*	8.918*	9.216*
	(3.485)	(0.999)	(6.291)	(0.996)	(4.708)	(5.085)
Spec_prod	9.914**		18.999**		15.870***	
	(3.910)		(8.193)		(5.661)	
spec_trade		-5.868**		-5.736**		6.790
		(2.237)		(2.261)		(6.949)
financial	-7.312	-5.823**	-2.462	-5.920**	-21.748*	35.392**
	(6.039)	(2.512)	(11.646)	(2.514)	(11.324)	(17.752)
border	1.530*	-0.521*	2.379*	-0.512*	-0.499	1.507**
	(0.886)	(0.269)	(1.365)	(0.269)	(0.685)	(0.656)
language	-0.132	-0.160	0.027	-0.164	-0.005	0.190
	(0.164)	(0.154)	(0.268)	(0.152)	(0.474)	(0.363)
ldistance	0.433	-0.069	0.902*	-0.063	-0.170	0.506
	(0.288)	(0.160)	(0.531)	(0.160)	(0.458)	(0.350)
lpopi	-0.072	-0.716***	-0.043	-0.708***	0.109	0.902
	(0.122)	(0.261)	(0.235)	(0.261)	(0.273)	(0.810)
lpopj	0.012	-0.430**	0.457	-0.425**	2.251	0.708
	(0.201)	(0.193)	(0.464)	(0.192)	(1.653)	(0.596)
Constant	-4.710	10.842***	-14.179*	10.674***	-17.091	-20.813*
	(3.508)	(3.533)	(7.383)	(3.588)	(12.868)	(12.001)
AR(1)	-1.68 (0.092)	-3.27 (0.001)	2.53 (0.011)	-3.29 (0.001)	2.15 (0.031)	1.90 (0.058)
AR(2)	1.08 (0.282)	1.45 (0.148)	1.48 (0.140)	1.41 (0.158)	1.32 (0.187)	1.62 (0.104)
Sargan/Hansen	8.68 (0.118)	5.59 (0.848)	4.59 (0.332)	5.57 (0.782)	10.08 (0.184)	5.15 (0.273)
Observations	858	858	858	858	858	858
Number of id.	78	78	78	78	78	78

Notes: Standard errors in parenthesis. ***, ** and *: significant at the respective threshold of 1%, 5% and 10%.

Source: Author

6. Conclusion

Although intra-industry trade is weak within ECOWAS, promoting and developing regional integration is essential. Given the context of numerous crises (political, social, security, and health) within ECOWAS, analyzing the endogeneity OCA thesis is relevant. Using system-GMM estimator, we find positive and significant effect of intra-industry trade on business cycle synchronization, which is consistent with the literature. Based on these findings, the introduction of a single currency for the ECOWAS zone could be recommended as the synchronization of business cycles between countries reduces the costs of its adoption. Policies to promote intra-industry trade could eliminate obstacles to the development of trade, such as the lack of harmonization of trade regulations and the existence of tariff barriers in the zone.

A strong synchronization of business cycles among ECOWAS countries presents several strategic opportunities. Firstly, it enables better coordination of economic policies, facilitating quick and effective responses to external and internal shocks. This economic interdependence can enhance regional macroeconomic stability, making the entire area more resilient to economic fluctuations. In monetary terms, increased synchronization could justify the establishment of a monetary union, reducing transaction costs and encouraging cross-border investments. A common currency would also allow for harmonizing monetary policies, contributing to greater transparency and predictability for investors. This could attract more foreign investment and stimulate intra-regional trade, thereby strengthening the economic growth of member countries.

In addition, economic policies should promote the openness of regional banks for the development of financial institutions. Better access of countries to international financial markets would increase foreign direct investment (FDI) flows. This could be facilitated through the broad participation of the local and international private sector. Foreign financial institutions are more likely to introduce and use new financial instruments and technologies in local markets, thereby increasing FDI inflows. Thus, the synchronization of economic cycles within ECOWAS represents an important catalyst that could increase economic gains in the event of the establishment of a monetary union.

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Appendices

Table A1. Degree of BCS of ECOWAS countries over the period 2000-2020

	BEN	BFA	CPV	CIV	GMB	GHA	GIN	MLI	NER	NGA	SEN	SLE	TGO	ECOWAS
BEN	1													
BFA	0.359 (1.675)	1												
CPV	0.457** (2.241)	0.680*** (4.046)	1											
CIV	-0.166 (-0.731)	-0.804*** (-5.886)	-0.664** (-3.867)	1										
GMB	0.413* (1.9745)	0.451** (2.201)	0.533*** (2.742)	-0.421** (-2.022)	1									
GHA	-0.222 (-0.991)	-0.002 (-0.007)	-0.298 (-1.360)	-0.076 (-0.330)	-0.287 (-1.306)	1								
GIN	0.165 (0.729)	-0.136 (-0.597)	-0.019 (-0.083)	0.278 (1.263)	-0.092 (-0.402)	-0.062 (-0.271)	1							
MLI	0.142 (0.623)	0.129 (0.568)	0.141 (0.623)	-0.184 (-0.817)	0.307 (1.405)	-0.679*** (-4.027)	0.149 (0.656)	1						
NER	0.434 (2.099)	0.710 (4.395)	0.383 (1.805)	-0.409* (-1.960)	0.289 (1.314)	0.080 (0.349)	-0.071 (-0.309)	-0.007 (-0.029)	1					
NGA	-0.095 (-0.418)	-0.047 (-0.204)	-0.237 (-1.064)	-0.250 (-1.126)	-0.186 (-0.824)	0.241 (1.082)	-0.640*** (-3.627)	-0.217 (-0.968)	0.040 (-0.174)	1				
SEN	0.482** (2.395)	0.763*** (5.136)	0.770 (5.254)	-0.508*** (-2.572)	0.615*** (3.398)	-0.545*** (-2.834)	0.038 (0.166)	0.382* (1.798)	0.467** (2.304)	-0.357 (-1.668)	1			
SLE	0.040 (0.174)	-0.347 (-1.612)	-0.478** (-2.369)	0.294 (1.342)	-0.430** (-2.074)	0.556*** (2.912)	0.047 (0.207)	-0.549*** (-2.864)	-0.243 (-1.093)	0.468** (2.309)	-0.641*** (-3.639)	1		
TGO	0.233 (1.046)	0.555*** (2.904)	0.051 (0.223)	-0.460** (-2.257)	0.310 (1.419)	0.126 (0.554)	-0.164 (-0.723)	-0.012 (-0.054)	0.576*** (3.068)	0.191 (0.848)	0.349 (1.622)	-0.135 (-0.593)	1	
ECOWAS	-0.096 (-0.420)	-0.108 (-0.475)	-0.328 (-1.514)	-0.149 (-0.655)	-0.236 (-1.060)	0.362* (1.695)	-0.615*** (-3.400)	-0.327 (-1.509)	-0.035 (-0.151)	0.984*** (-2.224)	-0.454** (-2.224)	0.570*** (2.999)	0.173 (0.767)	1

Notes: Benin (BEN), Burkina Faso (BFA), Cabo Verde (CPV), Cote d'Ivoire (CIV), Gambia (GMB), Ghana (GHA), Guinea (GIN), Mali (MLI), Niger (NER), Nigeria (NGA), Senegal (SEN), Sierra Leone (SLE), Togo (TGO). t-statistics in brackets. ***, ** and *: significant at the respective thresholds of 1%, 5%, and 10%.

Source: Author based on World Bank Data (World Bank, 2021).

Table A2. Data and sources

Data	Sources
Distance between capitals (distance)	From CEPII site, http: //www.cepii.fr/francgraph/bdd/distances.htm
The dummy variable is equal to 1 if two countries share the same border (border)	Compiled by author
The dummy variable is equal to 1 if at least one of the countries is landlocked (landlock)	
The dummy variable is equal to 1 if both countries share the same official language (language)	
The dummy variable is equal to 1 if both countries have the same colonizer (colon)	
Exports FOB et imports CIF of goods in constant US Dollars	World Development Indicators
GDP constant US dollars	
GDP current US dollars	
Population (pop)	
Share of agriculture in GDP	
Share of industry in GDP	
Share of trade in GDP	
Foreign Direct Investments (FDI)	
Bilateral trade per product	World Integrated Trade Solution (abbreviated WITS), UN COMTRADE database, United Nations Statistics Division.