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International Journal of Energy Economics and Policy (IJEPP)

Reference: Agustiar, Memet (2020). Monetary integration among oil exporter countries : testing Kenen's product diversification hypothesis in the organization of Islamic cooperation. In: International Journal of Energy Economics and Policy 10 (3), S. 380 - 388.
<https://www.econjournals.com/index.php/ijeep/article/download/8970/5037>.
doi:10.32479/ijeep.8970.

This Version is available at:
<http://hdl.handle.net/11159/8368>

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Monetary Integration among Oil Exporter Countries: Testing Kenen's Product Diversification Hypothesis in the Organization of Islamic Cooperation

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Received: 14 November 2019

Accepted: 16 February 2020

DOI: <https://doi.org/10.32479/ijeep.8970>

ABSTRACT

Kenen (1969) hypothesizes that countries that are largely dependent on one export commodity could experience weaker monetary integration and synchronize the business cycle among them. This paper aims to retest Kenen's hypothesis, which is applied to the seven largest oil-producing countries in the Islamic world. This study employs the optimum currency area index and the Pearson correlation matrix to determine the degree of integration and synchronization of the business cycle. This study empirically proves that most oil-producing countries are tightly integrated. Kenen's hypothesis is less applicable to oil-exporting countries, especially oil countries that have a strong economic structure and higher welfare. This study successfully explains the new empirical finding that homogeneity in the export structure is not bad for monetary integration.

Keywords: Monetary Integration, Optimum Currency Area, Islamic Nations, Oil Countries

JEL Classifications: E42, F36, F33

1. INTRODUCTION

Assessments to examine the impacts of trade on monetary integration have been a dynamic area of empirical research. The classical optimum currency area (OCA) theory emphasizes the intensity of trade as an "ex-ante" criterion in forming monetary unions (Molle, 2017). However, the modern OCA theory suggests that it does not need to meet the "ex-ante" criteria, as the criteria will automatically synchronize "ex-post" (De Grauwe, 2018; Eichengreen, 2018). Frankel and Rose (1998) point out that trade relations and monetary integration are endogenous, and that the increasing trade is more easily enhanced after the countries form a monetary union. Kenen (1969) hypothesizes that the effect of trade on monetary integration is dependent on the export structure. If the export structure of nominated countries depends on only one dominant and similar product (such as oil), then the monetary integration among them might be weak.

Approximately 15 Islamic countries are very dependent on oil exports, in that it contributes more than 85% of their total manufacturing exports Statistical, Economic and Social Research and Training Center for Islamic Countries (SESRIC, 2018). Furthermore, theoretically, countries that are dominated by one export product can find the opportunity to import and export among themselves limited (Kenen, 1969), and the low trade intensity between them can reduce demand for their local currency, which, in turn, can lead to currency asymmetry (Mania and Rieber, 2019; Pentecôte et al., 2015). Kenen (1969) argues that factor mobility in an OCA is more likely to occur if there is a diversified external trade structure in that product diversification allows one country to export and import various goods. Hence, how relevant the Kenen criterion is in explaining integration and synchronization in oil-producing countries is an interesting research question that is tested in this paper.

The Organization of Islamic Cooperation (OIC) countries provide two-thirds of the world's crude oil and natural gas reserves. The

OIC's share of oil production grew from an average of 50% in 1990 to 65% in 2015 (SESRIC, 2018). Saudi Arabia has the highest crude oil production, with 557.942 kt of oil equivalent energy production, or about 17% of the total oil production in the OIC (SESRIC, 2018), followed by Indonesia (351.841 kt), Iran (349.781 kt), Nigeria (228.721 kt), UAE (169.799 kt), Algeria (152.291 kt), Kazakhstan (145.814 kt), Qatar (139.945 kt), Kuwait (13.240 kt), and Iraq (119.640 kt). Although these countries supply 75% of oil production in the OIC, big oil producing countries do not always export large quantities of oil. For example, Iran, the second largest oil producer in the world, is only 70% reliant on oil exports, which is slightly below that of the majority of oil observed countries. This paper only considers countries that have the largest percentage of oil exports (80% and above) from their total manufacturing exports.

An abundance of oil may provide a blessing or a curse for the economy (Brunnschweiler, 2008). Oil-producing countries enjoy higher GDP growth, a surplus trade balance, and huge foreign exchange reserves (Gazdar et al., 2019), and countries that have strong foreign exchange reserves are able to maintain the stability of their currencies due to their large capacity to control the money market (Tiba, 2019; Brunnschweiler, 2008). Therefore, the strength of their foreign reserves may minimize the unexpected weaker integration that might arise from Kenen's hypothesis. Moreover, dependence on oil does not make integration among GCC countries weaker integration (Albaity and Mustafa, 2018; Echchabi et al., 2011). In contrast, Raison (2011) evidences that rapid economic progress in the Gulf countries does not guarantee that they would be able to form a currency union.

The Dutch disease theory asserts that oil-producing countries generally experience excessive levels of inflation (Bjørnland and Thorsrud, 2016; Corden and Neary, 1982). With regard to this theory, oil-producing countries may experience difficulty in achieving a prime level of integration due to extreme inflation. However, Fleming (1971) emphasizes that monetary integration and synchronization of the business cycle do not depend very much on high or low inflation rates, and that the most important is the similarity of inflation. Similarities in inflation can occur in conditions of high inflation rates or vice versa. In addition, generally, the characteristics of inflation in oil-producing countries stem from external demand, which is considered to have a better impact on the economy than inflation driven by the money supply (Omolade et al., 2019; Chen, 2009). Furthermore, rising oil prices encourage appreciation in producing countries (Narayan, 2013; Lizardo and Mollick, 2010). The fixed currency regime that is implemented in most OIC countries is considered capable of controlling their inflation (OIC Outlook, 2012), while the high inflation for Iran and Iraq might be caused by factors of domestic political stability rather than being due to external demand (Katsos and AlKafaji, 2019).

The extent to which Kenen's hypothesis may work among oil producer countries is an interesting question to study. The study involved seven Islamic countries that have export percentages that are above 85% of their total manufacturing exports. This research is expected to provide a new empirical explanation

regarding the pattern of monetary integration and synchronization of business cycles that specifically focuses on the oil exporting countries. The structure of this paper is as follows. Section 2 presents the literature and empirical review. Section 3 provides the computational methodology of the level of monetary integration and synchronization. Section 4 discusses the findings of this study, and the last section provides the conclusions and recommendations.

2. LITERATURE REVIEW

The three most prominent proponents of the OCA theory, Mundell (1961) - McKinnon (1963) and Kenen (1969), introduced a number of key criteria as preliminary prerequisites for joining a currency union. Mundell (1961) proposed free factor mobility and symmetrical macroeconomic shocks. McKinnon (1963) proposed trade openness and economic size as key criteria. Potential member states can join currency unions if they have symmetrical and synchronous macroeconomic fundamentals (Tavlas, 2009; Molle, 2017). The terms of symmetry, synchronization, and integration are dominant in explaining the main conditions for monetary integration (De Grauwe, 2018). Slightly different, Kenen (1969) promoted the opposite term, namely, that the external trade structure of the candidate member states should not be homogeneous. Homogeneity in the export structure is bad for monetary integration, and candidate countries with a diversified export structure are better at accelerating factor mobility, particularly goods and services.

Product diversification criteria may be explained in a simple way (Cadot et al., 2010). In a country that depends on only one export product, if there is a negative demand shock, the export revenue will drop. For example, a decline in the demand for oil would result in a decline of the foreign exchange reserves, which, in turn, would depreciate the domestic currency. This is because, if there is a negative demand shock, export substitution products cannot be provided rapidly. Learning from the 1970s oil crisis, the economies of the oil-producing countries were crippled because oil substitution products were very limited (Bini et al., 2016). Generally, countries with more diversified exports are more capable of fighting shocks.

Previous studies have emphasized the pattern of relationships between BCS on monetary integration. Generally, they assess the positive impact of BCS on monetary integration or vice versa (Frankel and Rose, 1998; Calderon et al., 2007; Antonakakis and Tondl, 2014). Some studies concluded that synchronizing business cycles in Islamic countries is not as strong as the exchange rate symmetry (Khan, 2009; Agustiar, 2020; 2019). Theoretically, this result contradicts Balasa's integration theory, which states that the output symmetry must be initially and more easily achieved than the exchange rate symmetry. The low level of trade intensity in many Islamic countries makes BCS a little more difficult to attain compared to exchange rate synchronization.

Numerous empirical studies have examined the negative effects of oil abundance in oil-producing countries, and found that a strong dependence on oil exports may have a detrimental effect compared

to countries that do not (Maalel and Mahmood, 2018). The relationship between oil abundance and growth is both negative and non-linear, encouraging rapid growth in the short term, but slowing in the long run (Sala-i-Martin and Subramanian, 2013). Rising oil prices can lead to a trade deficit with a shift in wealth from oil-importing countries to the oil-exporting economy (Ishaq and Mohsin, 2015). Lowering oil price may cause a current account deficit in. A lower oil price may cause a current account deficit in oil exporter countries (Basher et al., 2012), with the trade deficit continuing to widen due to the absence of alternative export products that can support the national economy. This is why most oil-producing countries promote popular policies to diversify their external trade structures. Maalel and Mahmood (2018) found that the lack of dependence on oil exports had a good effect on economic growth. The Dutch disease theory asserts that the local currency tends to appreciate when an oil boom occurs due to (1) increasing foreign exchange transactions, (2) increasing foreign investment, and (3) increasing export earnings from oil resources. In the era of an oil boom, the economy tends to overheat and push the huge mobilization of labor from the traditional sectors to the mining sector.

There are several explanations regarding the stages of integration in OIC countries. First, the OIC countries are heavily dichotomized into the group of oil-producing countries with high welfare and a relatively backward group of non-oil countries. In the oil-producing countries, the intensity of trade often goes hand in hand with the stability of the currency (Agustiar, 2019). Unlike the case of the non-oil countries, which often experience a strong dependence on imports that results in an unstable exchange rate when faced with external shocks. Second, the exchange rate regime of the OIC countries generally adheres to a fixed regime pegged to the US Dollar and Euro (Poon and Hooy, 2013; OIC Outlook, 2012). For oil-exporting countries, the regime stimulates benefits because they have an abundance of foreign exchange reserves to control currency volatility. This is why symmetry in prices (exchange rates) is easier to achieve than output symmetry.

3. DATA AND METHODOLOGY

3.1. The Data

This study selected seven countries as observations to represent the countries with the largest proportion of oil exports among the OIC member countries. The seven countries are Iraq, Algeria, Nigeria, Brunei Darussalam, Kuwait, Qatar, and Saudi Arabia (Table 1). The data in Table 1 provide the average oil exports and average oil production over 32 years (1985-2017) for the seven selected countries. The countries with the largest oil exports are not always the biggest oil-producing countries. Brunei, which is heavily dependent on oil exports, has the smallest oil production. In contrast, Saudi Arabia, which has the largest oil production, only depends on oil exports for around 85%. The monetary integration data are taken from the data concerning the changes in the nominal exchange rates of each country against the dollar. The synchronization of the business cycle data is taken from the data of changes in the output (GDP) of each country. The data source for the statistics was the SESRIC; www.SESRIC.org.

Table 1: Fuel export and energy production in selected OIC nations

Country	Fuel exports of merchandise exports (in %)	Average of energy production (thousand metric tons of oil equivalent)
Iraq	98.54	127,876.33
Algeria	97.66	150,630.06
Nigeria	93.10	235,157.53
Brunei D	93.04	19,442.83
Kuwait	92.49	142,180.33
Qatar	87.08	136,678.69
Saudi Arabia	86.56	557,942.54

Source: SESRIC, 2018

For the purposes of statistical testing, the data are processed in two ways – data for calculating the level of monetary integration and the degree of business cycle synchronization. In doing so, monetary integration is calculated using two separate approaches. One is the OCA-index (Bayoumi and Eichengreen, 1997) and the second is the Pearson correlation test (Frankel and Rose, 1998). To calculate the OCA-index, we use the data derived from the change in the nominal exchange rate for each country from 1971 to 2017 (46 years). Using the same data, we also estimate the correlation coefficient using the Pearson correlation matrix to measure the degree of integration of two pairs of countries. To calculate BCS, we use the annual GDP change data according to the current prices for each country from 1971 to 2017 (46 years).

The data from the OCA and BCS calculations are used to test the causality between BCS and OCA. There are two data that are used differently. First, we test all the panel data for OCA and BCS in 43 OIC countries with a 46-year time series (1971-2017). The permutation results of the panel data of 43 countries and 46 years were 988 observations. All of the above data sources were obtained from SESRIC: <http://www.SESRIC.org/oicstat.php>.

3.2. The Model

3.2.1. OCA-index

This study calculates monetary integration using the OCA-index approach derived from Bayoumi and Eichengreen (1997), which measures the level of monetary integration between two pairs of countries. The OCA-Index model is as follows:

$$OCA = \sigma(\delta \ln e_{ij}) \quad (1)$$

Where *OCA* is the *OCA* index, σ denotes standard deviation, and *e* refers to the nominal exchange rate of country *i* and *j*, δ denotes the change for *e*, *ln* is natural logarithm, *t* refers to time, and *i* and *j* are country *i* and *j*. The author classified the *OCA*-indices into three categories based on the classification of Bayoumi and Eichengreen (1997). First, pairs of countries that have an *OCA*-index that varies from 0.0000-0.0250, 0.0251-0.0770, and <0.0770 are nominated as the prime converged countries, the converging countries, and the little converged countries, respectively. The second approach is to examine the correlation coefficients of the nominal exchange rate changes between two pairs of countries using the Pearson correlation matrix. The strength of the integration of the two countries is shown through the *OCA*-index and the correlation coefficient (*R*), respectively.

3.2.2. Business cycle synchronization model

We also develop two models to estimate the degree of business cycle synchronization. One is the traditional model of BCS following Frankel and Rose (1998). The formula for the BCS can be written as follows:

$$BCS_{ij} = \text{corr}(Y_i^c, Y_j^c) = \left(\frac{\text{cov}(Y_i^c, Y_j^c)}{\sqrt{\text{var}(Y_i^c) \text{var}(Y_j^c)}} \right) \quad (2)$$

Where BCS_{ij} is business cycle synchronization. We use the GDP current price (Y) to proxy BCS. Y_i^c is the output growth of country i , and Y_j^c is the output growth of country j . We transform the GDP data on the logarithm form and calculate the change in GDP each year. We use this GDP change as the basis for comparison between country i and country j . The closeness in the difference between the GDP changes in country i and country j indicate a strong synchronization of the business cycle between the countries. A BCS value close to zero indicates a close business cycle synchronization between two countries. Second, we also run the Pearson correlation test to obtain a correlation coefficient between two countries to estimate the degree of business cycle synchronization. A BCS-index close to zero indicates greater synchronization of the business cycle, while coefficient correlations (R) close to one indicate strong business cycle synchronization between two countries.

3.2.3. Panel causality testing

To enrich the analysis, after modeling the degree of integration using the OCA-index and synchronization of the business cycle, we use the Dumitrescu Hurlin panel causality test model to develop a causality panel test between two variables – BCS and OCA. Since both variables are endogenous, it means the causality can be tested to determine the direction for each variable in response to another. The causality test model employs the Dumitrescu Hurlin panel causality test (Croissant and Millo, 2019; Breitung and Pesaran, 2008). We run two steps of testing – the causality test for all of the seven observation countries, and observations for four strongly integrated countries.

Panel causality testing in the panel data takes the general form as follows (Baltagi, 2008):

$$y_{i,t} = \alpha_{0,i} + \alpha_1 y_{i,t-1} + \dots + \alpha_k y_{i,t-k} + \beta_1 x_{i,t-1} + \dots + \beta_k x_{i,t-k} + \varepsilon_{i,t} \quad (3)$$

$$x_{i,t} = \alpha_{0,i} + \alpha_1 x_{i,t-1} + \dots + \alpha_k x_{i,t-k} + \beta_1 y_{i,t-1} + \dots + \beta_k y_{i,t-k} + \varepsilon_{i,t} \quad (4)$$

Where t denotes the time period dimension of the panel, and i denotes the cross-sectional dimension. y and x denote the variable uses.

The causality test needs some assumption to run (Pedroni, 2019; Breitung and Pesaran, 2008). First, we should ensure that the data are free from unit-roots. A set of data is expressed as stationary if the average and variant values of the time series data do not change (constant) systematically over time. Stationary data are needed to avoid spurious regression in estimation. The basic idea

of stationary is the law of probability that the process does not change over time in a statistically balanced process. The research conducted by Levin and Lin, Breitung and Meyer, Quah et al., Hadri and Im suggest the use of unit root tests in panel data models (Breitung and Pesaran, 2008). For each unit root test, the models are implemented with a deterministic trend and intercept. Levin, Lin, and Chu, and Breitung and Candelon assume a common unit root along the cross-sections. The rest Im et al., augmented Dickey-Fuller (ADF) - Fisher Chi-square - PP Fisher Chi-square assume single unit root and the autocorrelation coefficients change for the cross-section.

The unit root test model can be written as follows (Croissant and Millo, 2018):

$$y_{it} = \delta_{y_{it-1}} + \sum_{L=1}^{P_i} \theta_i \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it} \quad (5)$$

The unit root test hypothesis $P = 1$. The model can be rewritten as follows:

$$\Delta y_{it} = \rho_{y_{it-1}} + \sum_{L=1}^{P_i} \theta_i \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it} \quad (6)$$

Then, the unit root hypothesis is $P = 0$.

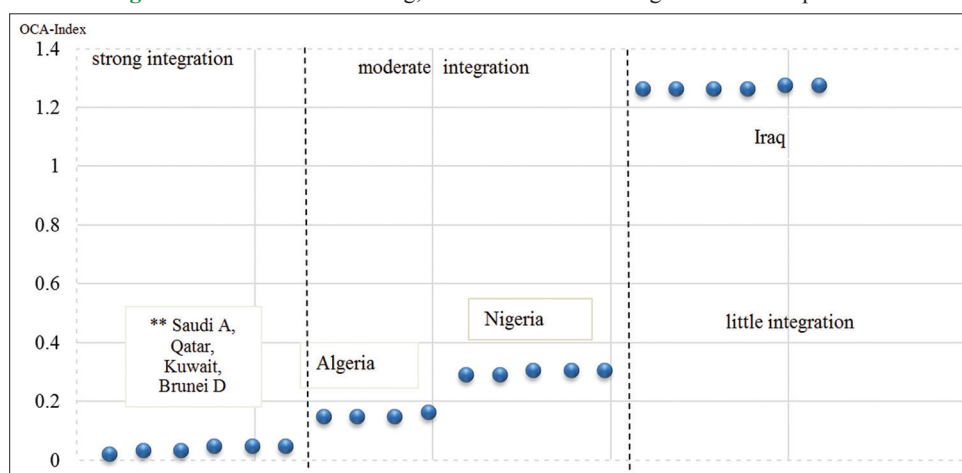
Some of the unit root tests for the panel data are based on the preliminary results obtained from the ADF regression. First, it must determine the optimal number of lags for the variable from the time-series data. First, we will determine the maximum number of lags to be selected. Then we can choose the lag using Swartz information criteria (SIC), Akaike information criteria (AIC), and the Hall method, which are chosen by removing the highest lags when the value is not significant. The ADF regression runs on observations $T - p_i - 1$ each individual, so the sum of all observations is $n \times \bar{T}$, where, $\bar{T} = T - p_i - 1$ is the average of lags. i.e., is a residual vector. The optimal lag determination used in this study is based on the shortest lag using the Schwarz Information Criterion (SIC).

4. RESULTS AND DISCUSSION

4.1. Monetary Integration

The calculation of the OCA-index and coefficient correlation (r) produce similar findings. Both models highlight a strong monetary integration among four countries (Saudi Arabia, North Sumatra, Qatar, and Brunei Darussalam), which is identified through the OCA-index value being below 0.025; the correlation coefficient is significant at the 1% level. Both models also emphasize a little integration among the other three countries (Algeria, Nigeria, and Iraq).

All four countries (Saudi Arabia, North Sumatra, Qatar and Brunei Darussalam) are consistently integrated with each other along three periods (1971-1989, 1990-2017, and 1971-2017). Saudi Arabia and Qatar have the strongest level of integration, followed by Saudi Arabia-Kuwait and Qatar-Kuwait. Accordingly, the Saudi Arabia Riyal is a good candidate for a parallel currency unit if these four countries would form a currency union. The presumption of a weak integration between oil-exporting countries does not

Figure 1: Distribution of strong, moderate and little integration in oil exporter countries


Source: Author calculation. **Values close to zero indicate a strong integration

happen for these four countries, hence, in this case, we reject the Kenen hypothesis.

Three countries – Algeria, Nigeria, and Iraq – lost integration with others (Figure 1). Algeria and Nigeria are in the group of countries with a moderate level of integration, with OCA index values between 0.13 and 0.28. Iraq is a country that is slightly integrated with other oil-exporting countries. Although there are indications that the Iraqi OCA index was highly integrated in the 1971-1989 period, it did not continue in the following period. Thus, Kenen's hypothesis works for these three countries.

This result is not surprising when compared with previous studies. Some empirical studies show that the monetary integration between Gulf countries is relatively strong (Bacha, 2008; Ruzita et al., 2011). Saudi Arabia, UAE, and Qatar have strong opportunities to form currency unions, including Kuwait. Indeed, in the period before 1990, there were indications that monetary integration between producing countries was relatively weak, but, over time, the trend of integration continued to strengthen. A recent study found strong monetary integration among Islamic countries when compared to two or three decades ago (Agustiar, 2019).

4.2. Business Cycle Synchronization

This is not very different from the results of the OCA-index, the calculation of BCS using the Parson correlation matrix results in a strong correlation coefficient occurring among four countries, namely, Saudi Arabia, Kuwait, Qatar, and Brunei Darussalam (Table 3). The strongest correlations are for Saudi Arabia-Qatar, followed by Saudi Arabia and Kuwait, and Qatar and Kuwait. This result is quite impressive because although the level of trade among them is relatively weak, the synchronization of the business cycle between them turns out to be strong. This means that trade integration is not a reason for business cycle synchronization. The currency movements of these countries are supported by strong foreign exchange reserves. BCS calculations also indicate that three countries – Iraq, Nigeria, and Algeria – have little integration with each other.

Although there are similarities in the pattern of monetary integration and business cycle synchronization for oil-producing

Table 2: Calculation of the monetary integration (OCA-index) and business cycle synchronization for the oil-exporting countries in the OIC

Country	OCA-indexes		
	1971-1989	1990-2017	1971-2017
Algeria-Brunei Darussalam	0.0812	0.17637	0.14749
Algeria-Iraq	0.07279	1.62879	1.26149
Algeria-Kuwait	0.06349	0.16233	0.13289
Algeria-Nigeria	0.26423	0.29128	0.2782
Algeria-Qatar	0.07151	0.15855	0.1313
Algeria-Saudi Arabia	0.07091	0.15855	0.1312
Brunei Darussalam-Iraq	0.02307**	1.62116	1.25215
Brunei Darussalam-Kuwait	0.02263**	0.03866*	0.03328*
Brunei Darussalam-Nigeria	0.26601	0.29447	0.28035
Brunei Darussalam-Qatar	0.02176**	0.04078*	0.03475*
Brunei Darussalam-Saudi Arabia	0.02485**	0.04078*	0.03568*
Iraq-Kuwait	0.02158**	1.62714	1.25647
Iraq-Nigeria	0.27253	1.61098	1.25436
Iraq-Qatar	0.01821**	1.62293	1.25291
Iraq-Saudi Arabia	0.02050**	1.62293	1.25243
Kuwait-Nigeria	0.27174	0.29827	0.28501
Kuwait-Qatar	0.01898**	0.02402**	0.02204**
Kuwait-Saudi Arabia	0.02031**	0.02402**	0.02257**
Nigeria-Qatar	0.27098	0.30414	0.28825
Nigeria-Saudi Arabia	0.26419	0.30414	0.2858
Qatar-Saudi Arabia	0.01633**	0.00000**	0.01265**

Source: Author calculation. **Prime converged countries, *converging countries, no mark is little converged countries.

countries in Islamic countries, we do not know whether there is a one-way relationship or causality between BCS and OCA. Previous studies empirically investigated two patterns of the OCA-BCS relationship. First, there is a strong influence of BCS on OCA. This confirms that BCS occupies a position as an initial criterion for forming an OCA. Another study concluded that BCS would only occur after OCA was formed. Further proof will be shown in this study for the need to look for causality between BCS and OCA in these selected countries.

4.3. Real Convergent Criteria

The author adds another explanation to investigate the characteristics of countries with a level of strong integration and

Table 3: Calculation of business cycle synchronization for oil-exporting countries

	Algeria	Brunei	Iraq	Kuwait	Nigeria	Qatar	S-Arabia
Algeria	1	-0.151	-0.043	0.260	0.128	0.234	0.196
Brunei		1	0.000	0.486++	0.140	0.347+	0.383++
Iraq			1	0.008	-0.030	0.072	0.046
Kuwait				1	0.229	0.559++	0.577++
Nigeria					1	0.137	0.184
Qatar						1	0.902++
S-Arabia							1

Source: Author calculation. ++Correlation is significant at the 0.01 level (2-tailed). +Correlation is significant at the 0.05 level (2-tailed)

Table 4: Real convergent criteria of monetary integration

Real criteria	Strong integration (Saudi-A, Qatar, Kuwait, Brunei-D) (on average)	Little integration (Algeria, Nigeria, Iraq) (on average)	Comparison*
GDP (constant price in USD)	233.2	259.6	=
GDP per capita (in USD)	43.911,5	4.128	><
Share of manufacture of GDP (%)	66.2	38.8	><
Share of agriculture of GDP (%)	0.925	12.1	><

Sources: SESRIC, 2018. *=Indicates similarity, ><=Indicates differences

vice versa. We use real convergence criteria, namely GDP size, GDP per capita, and economic transformation (represented by the share of manufacture and agricultural sectors within the GDP).

Table 4 distinguishes the similarity (=) and differences (><) between countries that have reached the level of prime integration and little integration. We collect average data on real economic indicators. First, prime convergent countries are countries that generally have a much higher GDP per capita compared to little integrated countries. Second, strongly integrated countries are associated with a high manufacture share in GDP and a low agriculture contribution in the economy (account for below 10%). Third, the average GDP size of the two integration groups (strong and weak) is relatively the same. This shows that the power of integration is not always influenced by differences in GDP size. This is, of course, because rich countries do not necessarily have a large GDP size, as many of them have small population sizes like Brunei Darussalam, Qatar, and Kuwait (Parnes, 2019; Ratty and Vespignani, 2015).

Figure 2 shows the pattern of relationships between real convergent criteria and monetary integration. The study found an inverted U-shaped indication between the level of integration with economic structure and welfare. In economies with low welfare and dominated by agrarian economies, monetary integration tends to be weak. Conversely, if the economic structure and prosperity become stronger, integration will also strengthen (Mongelli et al., 2017; Monfort et al., 2018). This finding is in line with the ex ante prerequisites proposed by the prominence in the OCA theory. Real convergence indicators are fundamental prerequisites that are considered important for forming a monetary union (Kutan and Yogit, 2005). The initial task is to group countries based on their economic structure and welfare status before we examine the classical nominal criteria.

4.4. Unit Root Test

The root unit test is used to check whether the data are stationary (free from the root unit). We divide the two categories of countries in this test, one is all countries (seven countries) and the other is

Table 5: Panel unit root tests (at level)

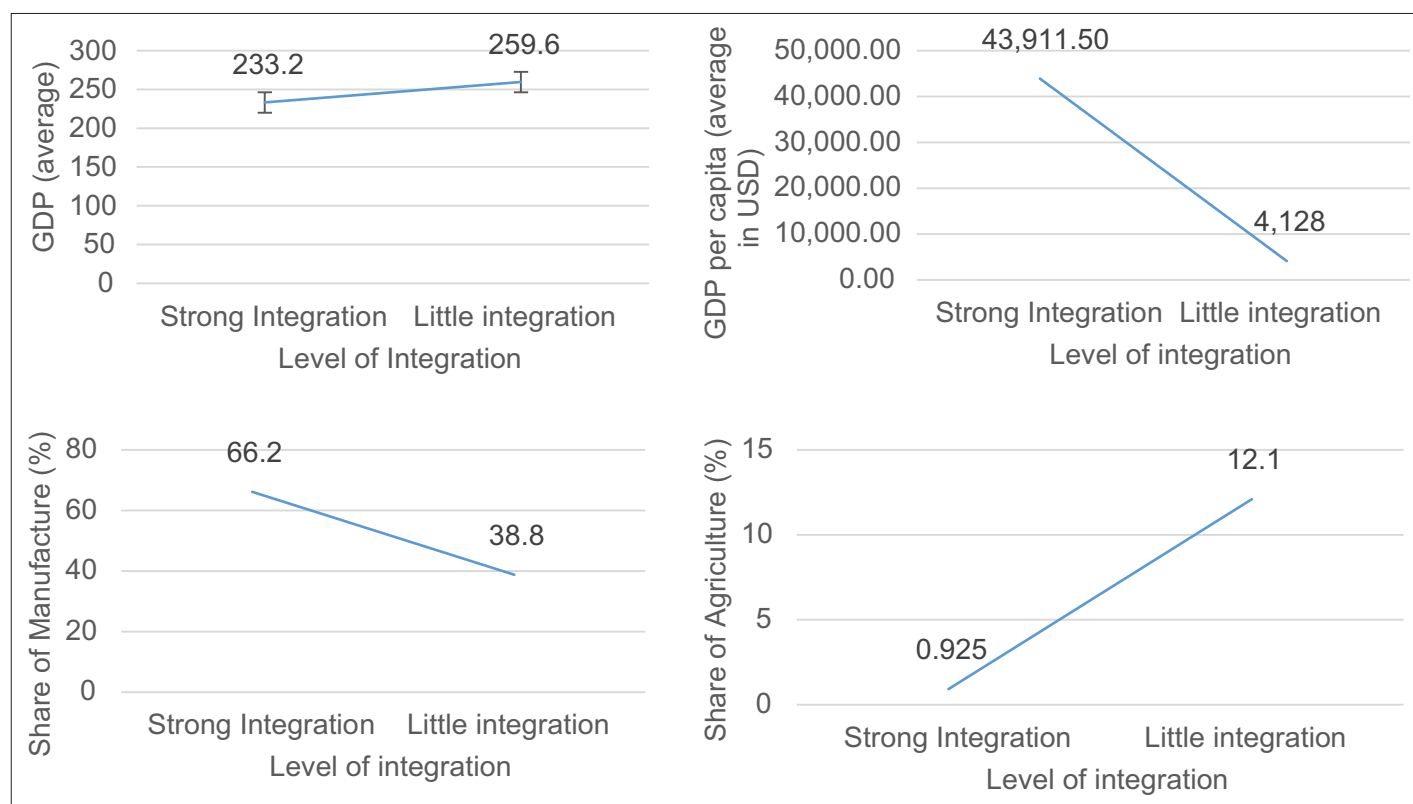
Method	Variables		Observation
	OCA	BCA	
Method for all (7) countries			
Levin, Lin and Chu t	-17.0315++	-10.254++	945
Breitung t-stat	-8.71211++	-10.2303++	924
Im, Pesaran and Shin W-stat	-14.369++	-9.3228++	945
ADF - Fisher	261.9067++	164.2204++	945
Chi-square			
PP - Fisher	531.1271++	343.3093++	966
Chi-square			
Method for 4 countries (Saudi Arabia, Kuwait, Qatar, and Brunei Darussalam)			
Levin, Lin and Chu t*	-16.3107++	-8.61767++	675
Breitung t-stat	-6.53619++	-8.58188++	660
Im, Pesaran and Shin W-stat	-12.2997++	-8.48223++	675
ADF - Fisher	187.829++	127.6815++	675
Chi-square			
PP - Fisher	316.471++	272.5187++	690
Chi-square			

Source: ++Represents 1% significance level. All variables are significant at this level

four countries with a strong degree of integration. There is no need to test the unit root for three countries in the weak categories because that would automatically be a reversal explanation regarding the strong one. Two variables are tested, namely OCA and BCS. The number of observations is 945, which are derived from 43 pairs of countries, and for 42-years. The total number of observations should have shrunk to 945 because there were outliers.

This study uses five models to detect root units, namely, Levin, Lin and Chu t, Breitung t-stat, Im, P Magnification and Shin W-stat, ADF - Fisher Chi-square, and PP - Fisher Chi-square. In Table 5, the results show that the BCS and OCA variables are both free from the unit-root at the level, as indicated by a significance level of 0.1%. These results indicate that there is no need for a cointegration test as this is only necessary if the data are not stationary at that level. However, because the unit-root test results show that all the

Figure 2: Predictive relation between real convergence criteria and monetary integration



Sources: Estimated from Table 4

data are stationary at that level, the causality test can be carried out perfectly in this study.

4.5. Lag Optimal Test

In order to produce the best estimate of causality, we must first measure the length of the lag on each variable. We use five models to measure the lag length, namely, the likelihood ratio (LR) sequential modified LR test statistic (each test at 5% level), final prediction error (FPE), AIC, SC: Schwarz information (SC) criterion, and Hannan-Quinn (HQ) information criterion.

Testing the optimum lag for all countries (seven countries) shows that the optimal lag is in the 14th year (Table 6). However, this study does not use lag 14 because the software Eviews does not provided facilities up to lag 14. Therefore, this study uses the possibility of other shortest lags, which appears to be in lag 12 (significant on the SC model). While the optimal lag in four countries is at lag seven (Table 6).

4.6. Results of Causality Test

The Dumitrescu Hurlin panel causality test model is used to determine the direction of the reciprocal relationship between OCA and BCS. This study divides the observed countries into two groups, namely, (a) a group of all countries (seven observations) and (b) a group of four countries that have a strong degree of integration. The main conclusions found in this study (Table 7) are, first, testing in the group of all the observed countries shows that there is no two-way reciprocal relationship (HO is rejected). Second, the causality testing for four countries shows that there

is a two-way (reciprocal) relationship between BCS and OCA as well as a one-way relationship from BCS to OCA.

These results indicate that endogeneity does not occur in the group of seven countries but appears in the group of four countries. This result also confirms that the one-way relationship from BCS to OCA occurs in the two groups of countries observed. These results contradict the empirical results of Frankel and Rose (1998), which emphasize the endogeneity between OCA and BCS. However, in the group of four countries, endogeneity really exists. That is, endogeneity is a factor that happens in countries with a strong degree of integration, the same as in the case of the monetary union in the European Union (Mongelli et al., 2017; Gomez et al., 2017; Willett et al., 2010; Antonakakis and Tondl, 2014). Another conclusion is that the one direction relationship from BCS to OCA occurs for the two groups of countries observed. Thus, we can conclude temporarily that BCS lies as an initial (ex-ante) criterion for monetary union, as proposed by the prominence of the classic OCA theory.

The missing link between BCS and OCA (in seven observed countries) may be caused by factors that are not directly related to trading, such as foreign exchange reserves, and the similarity in the economic structure and welfare level. In the previous discussion, it was found that structural factors were more influential than temporary factors. As long as the economic fundamentals are strong, monetary integration (represented by exchange rate symmetry) will automatically occur. The conclusion is that monetary integration is more likely to be caused by fundamental or structural factors rather than temporary nominal factors.

Table 6: VAR lag order selection criteria for all (7) countries and four countries

Lag	LogL	LR	FPE	AIC	SC	HQ
3	-419.35057	50.02088	0.312978	4.514069	4.751594 ^{ab}	4.610268
7	-387.77546	15.33567	0.266258 ^{ab}	4.351828 ^{ab}	4.860811	4.557970 ^{ab}
12	-4497.18	52.03546	12.13745	19.68476	20.13234 ^a	19.86098
13	-365.15967	11.82154 ^{ab}	0.270968	4.366247	5.282417	4.737302
14	-4480.365	14.83098	11.68440 ^a	19.64660 ^a	20.16579	19.85101 ^a
17	-4469.165	12.03173 ^a	11.72784	19.65006	20.27666	19.89676

*Indicates lag order selected by the criterion. endogenous variables: OCA BCS, exogenous variables: C, sample: 1971 2017, included observations: 462. ^{ab}Indicate selection for all countries and four countries respectively

Table 7: Test causalities panel Dumitrescu Hurlin: Samples: 1971-2017

Null hypothesis	W-stat.	Zbar-stat.	Prob.
Test for all (7) countries (lags: 12)			
BCS does not homogeneously cause OCA	28.33736	5.466691	0.0000++
OCA does not homogeneously cause BCS	14.78167	-0.08949	0.928694
Test for four (4) the prime converged countries (lags: 7)			
BCS does not homogeneously cause OCA	5.955948	-0.83283	0.404942
OCA does not homogeneously cause BCS	8.859016	0.630042	0.528667

++Denote 1% significance level, correspondingly

5. CONCLUSION AND POLICY IMPLICATIONS

This paper aims to assess the monetary integration among oil-exporting countries in Islamic countries. Seven oil-exporting countries were tested by the OCA index and correlation matrix to assess the degree of monetary integration between them. This study found that Kenen's hypothesis was irrelevant in the case of the oil-producing countries in the OIC. Most of the countries observed were in the main convergence countries. There are four countries with strong integration, two countries in the medium category, and one country in the weak category. The structure of integration and synchronization among the seven countries calculated by either OCA or BCS produces the same pattern.

This study also examined the causality relationship between OCA and BCS. The causality test identified that although there is no two-way relationship for all countries there is for the four strongly integrated countries. A significant one-way relationship from BCS to OCA is evidenced in the two groups of observations. The one-way relationship between BCS and OCA is in line with the rule of ex-ante OCA criteria, while the two-way causality between BCS and OCA indicates the phenomenon of endogeneity. This finding shows that endogeneity happens in the group of four countries with strong integration. This finding is in line with the integration process in the European Union (Gomez et al., 2017; Willett et al., 2010).

This study contributes to new empirical findings, especially those related to OCA criteria. Two important conclusions are produced from this research. First, nominal criteria must be an important consideration in assessing "ex-ante" criteria for monetary unions. However, as this nominal indicator is only effective in assessing short-term changes, it is necessary to be

careful in drawing conclusions from this criterion. Second, we need to investigate the long-term criteria, that is, the criteria of real convergence. With these concrete criteria, we can classify groups of candidate countries in a similar economic structure. Countries that have strong economic structures and welfare levels tend to be easily integrated among themselves or perhaps vice versa. In the author's opinion, it is more important to identify the real convergence criteria at the initial stage, especially in the same economic structure, then, after that, we can measure integration using nominal criteria.

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