Study of Economic Integration and Synchronization of Business Cycles of Iran and BRICS Countries using Spatial Econometric Approach

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ABSTRACT
Given the widespread and intense competition in the new global economic environment, the formation of trade blocs could contribute to the countries in order to increase their competitive power. Applying the gravity model and spatial econometric model, the bilateral trade streams of Iran and BRICS group countries are investigated in this study. According to the results, the group countries have a positive integration whose existence is confirmed by spatial econometrics. The results show that the gravity model has well been able to justify the bilateral trade stream. The most important factors affecting trade between Iran and BRICS members are GDP and the degree of economic openness. The results of spatial econometric model also indicate that the group countries are spatially correlated. The explanatory power of the model, a significant and positive coefficient of GDP and economic freedom index of countries, are indicative of a justifiable economic integration of Iran and the group countries in terms of economy. This can contribute to Iran’s future economic plans for the integration with the poles of the world economy.

KEY WORDS: Spatial Econometrics, Regional Integration, the brics Group, Business Cycle Synchronization

INTRODUCTION

One of the most important features of the international system in today's world of globalization is the formation of regional convergence in the framework of international organizations and national efforts to eliminate tariff and non-tariff barriers in different parts of the world. Given the widespread and intense competition in the new global economic environment and given that developing countries cannot compete in the international arena without previous preparation; the formation of trade blocks can help countries to increase competitiveness, and strengthen the comparative advantages of member countries in international trade.(jalaee&derakhshideh,2014).

BRICS is the acronym for an association of five major emerging national economies: Brazil, Russia, India, China, and South Africa. The members of this group, except for Russia, are developing countries or emerging economies. This group significantly impacts international interactions and consists of economies with an accelerated growth. Moreover, this group includes about half the world’s population as well as 28 percent of the world’s economic power.

Similarity and correlation of business cycles of countries that tend to be located within a block or economic cooperation can play an important role in economic integration between countries; in case of periodic correlation between member states of a block, the possible costs of using counter-cyclical economic policies will become minimum. Synchronization of business cycles means that the ups and downs of cycle are the same over time. Also, the meaning of synchronization of business cycles is the correlation between changes in GDP between the two countries in a period of time.
Undoubtedly, trade liberalization and particularly WTO membership have undeniable costs for developing countries; although it is generally believed that primarily these expenses are lower than the costs of trade and economic isolation and secondly, in case of informed, intelligent and effective encounter, it can be reduced to a great extent in the medium-term and in the long-run it can be compensated; however, the fact that the costs of economic adjustment, liberalization and globalization approach is usually very low or there is the possibility of reduction and compensation, this does not exclude the possibility that in certain cases, poor and contradictory policies by policy-makers or special conditions of some communities will increase the costs of this process. This kind of concern about the costs and consequences of this global approach and trade liberalization through the WTO accession and the considerations after the Cold War has led to the condition where in some cases, countries around the world seek regionalism approach and creation of economic-trade blocks as a prelude to the approach of globalization to preserve their business relationships and also to maintain their positions in the existing international blockades on the economy and global politics (Fathi, 2002).

Given the essential role of BRICS group in the global economy; and the significant impact of this group on the economy of developing and developed countries, the study of the status of Iran in this group and the economic convergence of Iran with member countries of the group is particularly important. To estimate the economic convergence of Iran and BRICS group two generalized gravity model and spatial econometric tools are used individually. Gravity models are useful experimental tools that are widely used in the international trade in explaining trade flows to determining the bilateral business potential and examining the effect of convergence on bilateral trade. Using econometric methods, multivariate regression with panel data is calculated. Differences in spatial econometrics and general econometric are in the use of econometric techniques in sample data that has a spatial component.

Therefore, this article seeks to answer the question of whether economic convergence can exist between Iran and BRICS countries. Does spatial econometrics confirm the convergence? Accordingly, to answer the questions, after the introduction the second part includes literature, the third part includes the specification, the fourth part includes the model estimation and finally the conclusion is presented.

2. Literature Review:

In recent years models used in international studies have had a considerable progress and with a reciprocal trade approach between countries and regional blocks, the factors affecting international trade have been estimated.

Tereza (2012) by investigating business cooperation indicators among the member countries in BRICS as well as business cooperation between this group and the European Union concludes that during the time period between 1995 and 2009, the EU has had an important and helping role in the commercial cooperation in each member country of this group. Meanwhile, Russia has been the main commercial partner for the EU. Naude et al. (2013), by assessing the economic development pattern of the BRICS emphasizing on the industry sector between the years 1980 and 2010, shows that there is a significant difference between China’s development pattern and other member countries of BRICS. This difference happens in the industrialization policy of China. Regarding the industry and export sectors, China has had a higher success than other BRICS countries. Moreover, since 1995 domestic investment in this country earned more importance compared to FDI. Milo et al. (2013) by investigating the experiences of the BRICS members, proposed four factors including access to capital, investment in generative activities, social payments and economic policies for reaching growth and equality in these countries. Among the member countries, Brazil has been successful in this area. Regarding India, China and South Africa it can be said that despite the significant economic growth of these countries in the recent years, they have not been successful in income distribution. Deadorff (1998), completed the theoretical basis of the gravity model by showing that the equation of gravity is perfectly consistent with the trade model of Pomfret (2005) studied the trade policy in Central Asia and showed that unilateralism through WTO in homogeneous goods with complete competition. Mohammad Mafizur Rahman (2009) using the generalized gravity model and using panel data investigated the factors affecting on the imports of Bangladesh from its major commercial partners and the results of the study indicate that the determinants of imports of this country are the inflation rate of countries, the differences in per capita income, and the degree of their openness.

The shared borders between the countries had also a considerable impact on a country's imports from its trading partners. Sologa and Winters (1998) used the following gravity model to study the new preferential agreements that began in the early 90s. Based on the findings, forming a block has not led to increased foreign trade volume. In European Union and Free Trade Area of EFTA, trade diversion was detected and after controlling for gravity variables, the imports of European Union and EFTA have dropped significantly. In Latin American, the tendency to increase the exports has generally been accompanied by the increasing trend toward imports which shows the strong effects of their general trade liberalization. First time in 1988, Professor Anselin presented a perfect framework of spatial econometric facts in the book called "Spatial Econometrics, Methods and Models". In the past few years enjoying this way has been taken into consideration by the scholars of the regional science. In the study of Beugelsdijk and Van Schaik (2005), they examined the relationship between social capital and
economic growth in 54 regions of Europe using a spatial model survey and concluded that social capital has a significant positive effect on economic growth; So that a standard deviation of group activities increases the economic growth to 0.03%. Barro and Sala (1991) studied the economic convergence of the states of America and achieved the convergence rate of the U.S. as 1.9%. Also, Barro (1997) studied the convergence of 114 countries and concluded that there is not absolute convergence between countries. He considered the reason as structural differences between countries. Conditional convergence coefficient in this study was 2.5. Soleimani Movahed & Afshari (2010) in the paper of testing the theory of Heckscher-Ohlin -Samuelson in Iran’s intra-industry trade using dynamically estimation method, evaluated the effects of model variables of Heckscher-Ohlin-Samuelson on intra-industry trade of Iran and MENA countries during the period from 1999 to 2007, and showed that among the variables of Heckscher-Ohlin-Samuelson model, the human capital had the minimal impact on Iran’s intra-industry trade with MENA region countries and in most cases, the relative advantages of Iranian intra industry trade have not changed over time. Nikbakht (2011) in an article entitled Analysis of economic integration (bilateral foreign direct investment) in D8 group of countries using the generalized gravity model investigated the convergence of Islamic countries of D8 group and showed that GDP of capital (as mass of goods) guest and host countries and their geographical distance (as distance) are consistent with the theory of gravity. Andeconometric structure difference indicator and economic openness indicator play a positive role in bilateral trade flows. And the group moves towards convergence and can increase economic cooperation between members to move towards globalization Nikbakht, Jalaei and Mehrabi (2008), studying the economic convergence of Islamic countries of D-8 group using the generalized gravity model showed that GDP in the host and guest countries, the host country population, indicator of economic structural differences and openness of the economy indicator play a positive role on bilateral trade flows. The results also show that economic integration of D-8 group has increased the volume of foreign direct investment of the Member States. The convergence of Iran has no significance in this group and Iran’s membership of the group has not had any effect on Iran's economic situation. Dr Mohammad Reza Lotfali poor et al (2011) examined the economic convergence between Iran and Latin American countries in terms of trade block formation. In fact, the main objective of this paper is investigation of success or failure of block formation and its impact on the increase of bilateral trade between Iran and these countries. The results showed that the existence of economic cooperation between Iran and Latin America will lead to a significant increase in bilateral trade flows. In other words, trade block can increase the amount of trade among the member countries up to 89 percent. Akbari and Farahmand (2005) in a study examined the economic integration among Muslim countries with an emphasis on the role of the Persian Gulf states. For this purpose spatial econometric methods were used. The results showed that the structural transformation of the global economy in recent years made the economies more dependent and made influence on each other. And economic cooperation can increase trade, Economies of scale, technology transfer and improvement of economic prosperity and growth. Akbari and Moallemi (2005) investigated the effects of economic integration in the countries of the Persian Gulf on the international trade flows. These countries have a common border and therefore spatial dependence between them have an impact on trade flows. Also, the coefficient of dummy variable of integration indicates the fact that the volume of trade between countries in the Persian Gulf is less than the gravity model variables and to increase it, the countries must remove the trade barriers of cooperation contracts and use the potential and the benefits to each other. Najafi Alamdar and colleagues (2013) examined the Factors influencing the export of agricultural products in member countries of Eco in 1992 to 2008 using a model of the spatial model survey. The results indicate the spatial correlation between the countries. On the other hand, the GDP variables, exchange rates, and adjacent countries on agricultural exports have positive effects and the countries’ population had a negative effect on it. Sameti and Behnud (2012) in a study entitled "the effects of economic instability on human development in selected Asian countries" examined the effects of inflation, unemployment, stagnation in production, budget deficits and exchange rate fluctuations on human development through geographically weighted regression approach on spatial econometrics as a branch of study in selected countries in Asia. The results show that due to the spatial data, spatial econometric is superior to general econometric and geographically weighted regression as a sub-branch of spatial econometric method to GLOBAL. The spatial anisotropy of exchange rate parameters and budget deficits are confirmed but spatial dependence of human development has not been approved.

3. The clarification of model:
3.1. Gravity model:

The simple form of the gravity model is defined as follows which has been adopted from the Newtonian gravity model. This model describes the distant gravitation between two or more substances. And asserts that the gravitational force between two materials is proportional to their weights and inversely proportional to the square of the distance between these two materials. To estimate international commercial flows in the simplest case where there is no obstacle and encouraging, using these models, bilateral trade flows can be considered as a direct function of economic size of the two countries and an inverse function of the geographic distance between the two countries:
Although the gravity equation initially did not have theoretical basis, but relatively large R²'s have led many researchers to use the gravity equation as a measure for bilateral trade volume. For the first time, the gravity model was proposed to measure certain bilateral trade examples and to justify commercial blocks and then it was also used to examine the effects of regional integrations on foreign reciprocal investment. In its simplest form, the gravity model was originally developed by Tinbergen (1962) in economics which is directly derived from Newton's theory of gravity.

\[ T_{ij} = c \cdot \frac{GDP_i \cdot GDP_j}{D_{ij}} \]  

(1)

In this equation, \( T_{ij} \) is exports (imports) of country i to (from) j. \( Y_i \) is income of country i, \( Y_j \) is income of country j. \( POP_i \) is population of country i and \( POP_j \) is population of country j which appear as explanatory variables on the right side. \( Y_i \) and \( Y_j \) are considered as mass variables in Newton’s relation and demographic variables are two other scale variables. Following these variables, a set of dummy variables will be added to explain other effects on reciprocal trade flows between the two countries. \( D_{ij} \) is the dummy variable added to explain the other effects of the two countries’ mutual trade blocks. \( D_{ij} \) is the dummy variable for the common language between the two countries and \( D_{ij} \) is the dummy variable related to the distance or proximity of the two countries.

The model used in this paper is generalized gravity model and is specified as follows:

\[ \ln XM_{ijt} = \alpha_{ij} + \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln labor \ force + \alpha_4 \ DIS_{ij} + \alpha_5 \ LIN_{ijt} + \alpha_6 SYNCH_{ij} + U_{ijt} \]  

(3)

XM: exports plus imports of the country at time t and shows the bilateral trade flows between exporter countries (i) and the importing countries (j). \( U_{ijt} \): an absissa that represents the specific effects of each of the partner countries and may vary depending on the trade orientation. \( GDP_{it} \) and \( GDP_{jt} \): real GDPs of country i and country j at time t which express the country’s economic size. \( labor \ force \): Represents the labor force participation rate in the country and is considered as one of the factors of production preceding a significant role to play in economic development. \( POP_i \) and \( POP_j \): Indicate exporter and importer countries populations which will represent the size of the market. Because this variable is effective on the market size and economies due to scale, it will have uncertain effects on bilateral trade flows. Open is the ratio of combination of import and export to GDP which is a measure for assessing the degree of openness in a country’s economy. Based on the previous literature, the bigger this ratio is, the higher the volume of international trade will be. Hence, it is expected that the impact of this measure on increasing mutual trade would be positive. In other words, the more open an economy is, the higher its trade volume would be. \( DIS_{ij} \): Geographical distance between economic centers (capitals of the two exporter and importer countries) of the two countries of i and j. Since the greater distance will impose higher transportation costs, it is expected to have negative effects on trade flows. \( LIN_{ijt} \): is Linder variable. In order to express the economic similarities between each pair of trading partner countries, \( Linder_{ij} \) variable as a function of per capita GDP for each pair of countries, is entered into the model:

\[ linder_{ij} = LN \left( \frac{GDP_i \cdot GDP_j}{POP_i \cdot POP_j} \right)^2 \]  

(4)

According to Linder trade theory, it is expected that the coefficient of this variable is negative. According to this theory, similar countries have more tendency to trade with each other than with other dissimilar countries (Arnon et al., 1996).

\( SYNCH_{ij} \): Indicator of trade cycle synchronization between countries i and j. Kalemli-Ozcan, Sebnem. Elias, Papaioannou, Luis, Peydro (2009) have calculated it as follows:

\[ SYNCH_{ijt} = -[ (\ln Y_{it} - \ln Y_{i,t+1} - (\ln Y_{jt} - \ln Y_{j,t+1})] \]  

(5)

in which \( Y_{it} \) is the real GDP of country i at time t and \( Y_{jt} \) is the real GDP of country j at time t. The more the value of this index in terms of the algebra and the closer to zero is, the greater would be the synchronization of trade cycles between the two countries.

According to Mandel and McKinnon, the synchronization of trade-cycles is a precondition for integration and cooperation of countries into a regional trade agreement; because the possible cost of anti-cycle economic policies are reduced with simultaneous trade cycles.

3.2. Spatial econometric model:

Conventional econometric technique that is based on assumptions of Gauss-Markov is flawed for regional studies. Research done in the area of the regional science, are dependent on sample data of the area that were collected due to the measurement location as a spot in space. In this case, the researcher faced with two phenomena in regional study data as: 1) the spatial dependence between observations, and 2) spatial heterogeneity.
3.2.1. Spatial Dependence:
In a set of sample data to mean that the observations in place I depend on other observation in place j. in other words:
\[ Y_i = f(Y_j), \quad i=1,2,…,n \quad \text{if} \quad i \neq j \] (6)
It is expected that the sample data observed at a point in space is related to the observed values in other locations.

3.2.2. Spatial heterogeneity:
Refers to the deviation between the observations are related to the level of geographic locations. (Lessage 1999) linear relationship is depicted as follows:
\[ Y_i = f(\text{X}_i \beta_i + \varepsilon_i) \] (7)
where \( i \) represents observations obtained in \( i=1,2,3,…,n \) points in space, \( \text{X}_i \) represents Vector \((k \times n)\) from explanatory variables with parameters \( \beta_i \) related to it, \( Y_i \) is the dependent variable I the observation or place I, and \( \varepsilon_i \) Represents the random error. In general, the spatial anisotropy violates the linear relationship with constant variance exists between sample observations. If the equation changes with the move between the spatial sample data spatial econometric estimation models will model these changes.

3.2.3. Spatial lag:
One of the basic concepts associated with space is spatial lag. Spatial lags are similar to the backward transfer in time series analysis and unlike the time series that lag occurs within the time, in spatial econometric interruption means the transmission over the space. So that \( \beta_y t = y_{t-1} \) represents the first lag and \( \beta_y t^p = y_{t-p} \) represents the \( p \)th lag. The concept of spatial lag is used for the relations “neighbors than neighbors”.

3.2.4. Diagnostic tests of spatial autocorrelation:
Moran test: Is used to diagnose the spatial autocorrelation regression disturbing components. This test demonstrates the spatial correlation is disturbing in parts. Statistic Moran is achieved as follows.
\[ I = \frac{e^T W e}{e^T e} \] (8)
Where \( e \) represents the regression disturbing components
Likelihood ratio and Wald test: These tests are used to test for spatial correlation in the disturbance components according to the difference between the likelihood logarithm of spatial error model and the likelihood logarithm of least squares regression.
Lagrange multiplier test: is conducted based on the residual least squares and calculation of the spatial weight matrix \( W \). In this study to detect spatial autocorrelation in the disturbance components, Moran tests, likelihood ratio and Wald and Lagrange multiplier tests are used to identify the appropriate model to address spatial autocorrelation.

3.2.5. First order spatial regression model (FAR):
The main application of this model is to detect the spatial correlation between neighbors. This model indicates the \( y \) changes as a linear combination of latitude and longitude.
\[ y_i = \rho \sum_{j=1}^{n-1} W_{ij} y_j + \varepsilon_i = \rho W y + \varepsilon_i \] (9)
\[ \varepsilon_i \sim N(0, \sigma^2) \]
\( W \) contains information about latitude and longitude of the country. We introduced \( W y \) as a spatial lag variable.

3.2.6. Mixed regression - autoregressive model (SAR):
In this model \( y \) is a linear combination of neighboring countries such as auto regression time series and since covariance in this model is not a diagonal matrix, estimation is done as inconsistent OLS and Maximum likelihood method is used in this model to estimate the parameters. The model is as follows.
\[ y_i = \rho \sum_{j=1}^{a} W_{ij} y_j + \sum_{k=1}^{b} \beta_k x_k + \varepsilon_i = \rho W y + X \beta + \varepsilon_i \] (10)
\[ \varepsilon_i \sim N(0, \sigma^2I_n) \]
For estimating, the model can be explicates as follows:
\[ \text{XMij} = a_0 \text{ (GDP)}^{a_1} \text{(POP)}^{a_2} \text{(SYN)}^{a_3} \text{(HER)}^{a_4} \text{(DP)}^{a_5} \] (11)
\[ \text{lnXMij} = a_{ij} + \alpha_1 \text{ln GDP} + \alpha_2 \text{ ln POP} + \alpha_3 \text{ SYN} + \alpha_4 \text{ HER} + \alpha_5 \text{ DP} + U_{ijt} \] (12)
The statistical population includes the BRICS countries & Iran (Brazil, Russia, India, China, and South Africa, Iran). The data from the period of 1989 to 2012 have been used. The data are extracted from compact discs of WDI, IMF, PC-TAS and UNCTAD.

4. Estimating the Model:

In this study, the issues raised in the first section of the gravity equation will be used to estimate and then the economic integration is being estimated using the spatial econometric model.

4.1. Estimating the gravity model:

Using the explicated equation (Equation 2) gravity model is examined by Hausman test and estimating the values of the coefficients and then estimating the model.

4.1.1. Hausman test:

In panel data method, both random and fixed effects estimations are discussed. Due to the fact that sometimes a huge difference exists between the estimates obtained from these two methods; Hausman test is used to choose between the two methods. According to the results of Table 1 it can be noted that, with a probability of over 90%, there is no reason for rejecting the hypothesis Ho which indicates random effects against fixed effects and the method of random effects which has a high explanatory power is preferred and the results analysis is done based on it.

Table 1: Results of pattern selection (bounded F-test and Hausman test).

<table>
<thead>
<tr>
<th>p-value</th>
<th>Test statistic</th>
<th>Test type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2.92E+24</td>
<td>F</td>
</tr>
<tr>
<td>0</td>
<td>212655.965369</td>
<td>H</td>
</tr>
</tbody>
</table>

Source: Calculations of the researcher

4.1.2. Estimating the Model:

According to Table 2, the overall estimation results with R2 more than 88 percent, indicates that the Gravity model could largely explain the bilateral trade flows of Iran and BRICS group and the coefficients are statistically examined at the 99% confidence level.

Table 2: Results of the estimation.

<table>
<thead>
<tr>
<th>variable</th>
<th>coefficients</th>
<th>t-statistics</th>
<th>Possibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNGDPI</td>
<td>0.919</td>
<td>24.76</td>
<td>0.00</td>
</tr>
<tr>
<td>LNGDPj</td>
<td>0.004</td>
<td>0.088</td>
<td>0.92</td>
</tr>
<tr>
<td>LNPOPj</td>
<td>0.021</td>
<td>1.89</td>
<td>0.06</td>
</tr>
<tr>
<td>LNPOPI</td>
<td>0.020</td>
<td>0.64</td>
<td>0.51</td>
</tr>
<tr>
<td>OPEN</td>
<td>0.680</td>
<td>4.52</td>
<td>0.00</td>
</tr>
<tr>
<td>DIS</td>
<td>2.54E-05</td>
<td>3.01</td>
<td>0.00</td>
</tr>
<tr>
<td>LIN</td>
<td>-0.013</td>
<td>-2.21</td>
<td>0.02</td>
</tr>
<tr>
<td>SYN</td>
<td>0.007</td>
<td>1.94</td>
<td><strong>0.05</strong></td>
</tr>
</tbody>
</table>

R2 = 0.88

Source: Calculations of the researcher

GDP is considered as an indicator for the economic size of a trade partner. Based on the obtained results, the Iranian GDP has had a significant role in determining the mutual trade volume and has a positive coefficient. This result is in conformity with the research hypothesis. The estimated coefficient indicates that, by keeping the other variables constant, a one percent increase in Iranian GDP leads to an increased foreign trade and the domestic market attracts more foreign goods and products and on average the domestic trade volume shows a 91 percent increase. The population of Iran is significant and has a positive coefficient so that a one percent surge in the population volume leads to a 0.021 increase in the mutual trade flow. The degree of openness has the expected sign and can indicate the fact that the more a country gets powerful regarding trade volume with other countries, the higher the tendency is to trade inside the group and the lower is the tendency to trade outside the group. The variable for distance is statistically insignificant and has a positive sign. The integration degree of these countries overshadows the impact of distance on convergence trend and it can be said that the globalization trend decreases the importance of distance and distance cannot hinder international trade. Leander variable used for assessing the impacts of economic similarity between the member countries on the trade flow has the necessary sign and is statistically significant. The results show that the economic similarity among the member countries can have a positive effect on their trade flow volume. In order to investigate the effects of business cycle synchronization on the convergence of member countries, the syn variable has been added to the model. According to Table (2) the variable for business cycle synchronization has a positive sign hence the effects of business cycle synchronization on the mutual trade volume of the member countries can be seen.
Hence, business cycle synchronization has a positive effect on economic convergence and the higher business cycle synchronization among the member countries is, the higher the possibility of economic convergence.

4.2. Estimation of spatial econometric model:

According to the specified model, the following steps are taken to estimate the model:

4.2.1. Moran, likelihood ratio and Wald tests:

The null hypothesis in all three tests is the absence of spatial autocorrelation in disturbing components and since the Moran statistic value is greater than 1.96 and the likelihood ratio and Wald statistic values are greater than 6.635, the null hypothesis is rejected. By rejecting the null hypothesis as the lack of spatial autocorrelation, spatial econometrics can be used.

Table 3: Results of Moran, likelihood ratio and Wald tests.

<table>
<thead>
<tr>
<th>statistic</th>
<th>coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>MoranI-statistic</td>
<td>1.9654</td>
</tr>
<tr>
<td>Probability</td>
<td>0.0494</td>
</tr>
<tr>
<td>Walds</td>
<td>21.9776</td>
</tr>
<tr>
<td>Probability</td>
<td>2.75 e-06</td>
</tr>
</tbody>
</table>

Source: Calculations of the researcher

4.2.2. Lagrange multiplier tests:

The null hypothesis of lmerror and lmlag tests is the lack of spatial correlation in disturbing components and the lack of spatial dependence in the dependent variable observations. Test results in Table 4 show that the SAR model should be used to remove the disturbing elements of spatial autocorrelation.

Table 4: Lagrange multiplier test.

<table>
<thead>
<tr>
<th>statistic</th>
<th>coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lmerror</td>
<td>1.1041</td>
</tr>
<tr>
<td>Probability</td>
<td>0.2934</td>
</tr>
<tr>
<td>Lmlag</td>
<td>17.5766</td>
</tr>
<tr>
<td>Probability</td>
<td>2.7596 e-05</td>
</tr>
<tr>
<td>Lmerror_robust</td>
<td>16.5935</td>
</tr>
<tr>
<td>Probability</td>
<td>4.6309 e-05</td>
</tr>
<tr>
<td>Lmlag_robust</td>
<td>33.0660</td>
</tr>
<tr>
<td>Probability</td>
<td>8.9082 e-09</td>
</tr>
</tbody>
</table>

Source: Calculations of the researcher

4.2.3. Estimation of FAR model:

The results of estimating equation in Table 5 show that the spatial coefficient $\rho$ is equal to 0.9779, which is statistically significant and indicates the positive spatial correlation among the countries.

\[
\ln(ex + im)_t = \rho (W \ln(ex + im)_t) + \varepsilon_i \\
\varepsilon_i \sim N(0, \sigma^2 I_n)
\]

(13)

Table 5: The results of estimating FAR model.

<table>
<thead>
<tr>
<th>test</th>
<th>coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho$</td>
<td>0.991961</td>
</tr>
<tr>
<td>Asymptot t-stat</td>
<td>516.564357</td>
</tr>
<tr>
<td>$\varepsilon$-probability</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Source: Calculations of the researcher

4.2.4. Estimation of SAR model:

Table 6 represents the results of estimating the following equation.

\[
\ln(XM_t) = \beta_0 + \beta_1 \ln(GDP_t) + \beta_2 \ln(POP_t) + \beta_3 (SYN)_t + \beta_4 (HER)_t + \beta_5 DP + u_t \\
+ \beta_6 DP + u_t \\
u_t = \lambda (Wu_t) + \varepsilon_t \\
\varepsilon_t \sim N(0, \sigma^2 I_n)
\]

(14)

Table 6: The results of estimating SAR model.

| variable          | coefficients | t-statistics | Possibility |
|-------------------|--------------|--------------|-------------|-------------|

Source: Calculations of the researcher
According to the obtained results, GDP has had a significant role in determining the trade volume of Iran and it has a positive sign, which is in conformity with the research hypothesis. The estimated coefficient indicates that, while keeping the other variables constant, a one percent increase in the GDP of the member countries, on average explains 98 percent of the mutual trade flows of Iran. This increases foreign trade and the attraction of foreign products. Hence, the volume of foreign trade in the country increases. The variable for population is significant and with a positive sign, which indicates that countries with bigger population size have a higher tendency to trade inside the group and the population variable is a motivation for mutual trade in the group. The variable for business cycle synchronization has a positive sign and is statistically insignificant; hence the effect of business cycle synchronization on the mutual trade volume of the studied countries is a direct impact. Hence, business cycle synchronization has a positive effect on economic convergence and the higher the business cycle synchronization among the member countries, the higher the possibility of economic convergence. The measure for economic openness, Heritage, is a detailed analysis on the factors which have the highest contribution to the institutionalization of economic growth and the majority of the current theories on the roots and factors of economic development can be seen in this measure. Based on the research results, the coefficient of this measure is significant and positive and indicates the fact that economic liberties have a significant role in the trade volume among the member countries. The coefficient for the virtual variable of DP which indicates the difference between the liquidity growths of the countries along with GDP is positive but it is not statistically significant.

5. Conclusions:
The developing countries are not able to compete in the global arena without necessary preparations. The formation of trade blocks can be a significant help for countries in order to increase their competitive capability. Hence, the current study investigates the mutual trade flows between Iran and the member countries of BRICS using the gravity model and spatial econometric model. The results obtained from the gravity model justify the mutual trade flow. The most important factor affecting the mutual trade between Iran and members of BRICS is the GDP of Iran and the degree of openness in the countries’ economies. The results obtained from spatial econometric model show that the member countries of BRICS have spatial correlation and the economic status of each country is affected by the region. The capability of the model to offer explanations and the positive and significant coefficient for the GDP of the countries indicates that the economic convergence between Iran and BRICS is justifiable regarding economy. Moreover, the positive and significant coefficient the measure for economic openness can be seen as an emphasis on the economic convergence between Iran and BRICS countries. In a nutshell, the results show that the presence of Iran in this group can be a good move towards union and due to the convergence inside the group; this action can improve the economic position of the group. These results can help the future economic plans of Iran to converge with global economic powers.

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