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The Impact of Maritime Transportation Instability on International Trade Instability: Combination Spatial Panel data Econometric Approach and Wavelet Smoothing

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Abstract

The main objective of this study is to evaluate the impact of maritime transportation instability on international trade instability based on wavelet smoothing and spatial panel data econometric method during the period 1990-2012. The results showed that the spatial effects have an impact on international trade instability. So that a sudden 100 percent increase in international trade in the neighboring countries will reduce 38 percent of trading in own countries. Evaluation of the results of spillovers elasticity of international trade instability showed that maritime transportation did not have a significant impact on international trade fluctuations and geographical concentration is the most important variable of instability in international trade.

Keywords: International Trade Instability, Biorthogonal Wavelet, Spatial Interaction, Maritime Transportation.

JEL Classification: F15, R12, E32, C21.

1. Introduction

One of the most important topics in the global economy is international trade. It is considered as the main source of foreign exchange earnings for investment and new technology in order to

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increase economic productivity (Krugman, 1980). So, based on what is stated in the theoretical principle, generally, international trade is divided into three types: One-way international trade (Inter-Industry international trade), two-way international trade in variety of same production, (horizontal IIT), Fragmentation of production (vertical IIT) (Abdol-Rahman, 1991). Accordingly, about the instability of international trade, the cause of the instability refers to first, type of international trade (intra- or inter industry), second, factors affecting each type of international trade. Certainly, today, in international trade world, there are three types of international trade. In this case, factors influencing three types of international trade will be effective on the instability of international trade while the internal situation in the neighboring countries influences on each other interactively. Most of research conducted in this area, have addressed the impact of exchange rate instability, geographic concentration and commodity concentration on international trade instability, which among them we can indicate to the studies of Hooper and Kohlhagen (1979), Cushman (1983), Peree & Steinherr (1989), Bahmani Oskooee & Latifa (1992), Yousefi (2000), Vergil (2002), Hondroyiannis et al. (2008), Bahmani-Oskooee and Kandil (2010), Trinh (2012) regarding to exchange rate instability, and Studies of Massell (1970), Macbean (1966), Massell (1970), Naya (1973), Souter (1977), Love (1987 & 1992), Tariq & Najib (1995), Tegen (2000), Sileshi (2003), Devkota (2004), Xin & Liu (2008) and Çakir and Kabundi (2011) in the case of commodity and geographic concentration.

The survey of literature reviews show that: first, instability is defined by the decomposition process and deviations around it; however, in recent years, time series analysis methods in the context of known filters like Hodrick-Prescott Filter (1997), Band-Pass Filter (Baxter and King, 1999) and the *wavelet analysis* is highly regarded. Second, in these researches, intra-industry international trade between variables is considered while in the real world every three types of international trade: Horizontal IIT, Vertical IIT and intra-industry international trade occurs. Third, the consequences of interaction effects among neighboring or spatial effects haven't been considered, although according to new economic international trade theories, spatial effects and regional interactions with other countries have been approved. Forth, Instabilities resulting from transport sector isn't taken into consideration. Accordingly, in this study, using wavelet smoothing, we investigated the factors affecting the instability of international trade with an emphasis on fluctuations in the maritime transport by using data from 34 significant countries in world international trade and maritime transport, which have more than 75 percent of world international trade and period from 1990 to 2012 through Spatial Panel data and Maximum likelihood Estimation method (ML). While Spatial Effects are evaluated by using a bilateral international trade matrix which is weighted by standardized geographic distance matrix.

2. Theoretical Framework

Reviewing the past, development of what is today as a standard theory of international trade returns in the years between 1776 and 1826; initiated respectively, with the publication of the "Wealth of Nations" by Adam Smith (1776), based on the theory of *absolute advantage* and "Principles of Economics" by David Ricardo (1828-1772), based on the theory of *Comparative Advantage*. The formulation of the theory of free international trade is discussed in these two books. Haberler (1968) formulated Ricardo's theory based on the opportunity cost (Baldwin, 1982). Ricardo's theory of comparative advantage could partly explain the cause of realization of the commodities exchange business and trading volume; but there is no explanation about why different countries have different relative costs. According to Heckscher (1919), Ohlin (1924) and later Samuelson (1949) (abbreviated by HOS), with inspiration from the balancing act between the forces of supply and demand of the Austrian school, the difference in the "relative factor endowments" and its prices are considered as the main determinant of comparative advantage of each country (Heckscher-Ohlin, 1991).

In great movement of transition from the old theories of free international trade, there have been done a lot of efforts in the theoretical literature on New International trade Theory (NTT). The new international trade theory generally has three main distinctions of the old theory (classical and neoclassical): first, “Economies of Scale”, second, “Imperfect Markets” and the third is “Product

Differentiation”. The idea of returning to the increasing scale of production can be seen as an international trade agent, initially was expressed by Graham (1923) and Ohlin (1933) (Feenstra, 2004). Basic literature on new international trade theory were presented by Lancaster (1975, 1979), Spence (1976) and Dixit and Stiglitz (1977). Lancaster showed that consumers from their "Ideal Variety" gained higher utility; therefore, this product can be distinguished from other goods (Lancaster, 1975). In contrast, Spence, Dixit and Stiglitz, with the introduction of the utility function in which the utility of various goods and not just a commodity have increased, introduced a consumer who makes utility with distinctive and diverse demand and introduced "Love of Variety" as the main topic (Spence, 1976; Dixit and Stiglitz, 1977). Krugman used love of variety of Spence, Dixit and Stiglitz. Lancaster and Helpman used an ideal variety (Feenstra, 2004) and built the foundations of the new international trade literature.

In most research related to the past international trade, little attention to the spatial aspects of the international trade, briefly described above, are discussed. Frankel (1988) argues that international trade theorists (International) and researchers have ignored the international trade geographically, so that they assumed countries as institution of foreign bodies that have no physical location in geographic space. Ullman (1957) argued that international trade flows are determined by complementarities, intervening opportunity and transferability. According to his three based spatial interaction, trading occurs when there are two areas of a market-clearing supplier of portable products (complementarities), when there is no other source (intervening opportunity) and when transport costs are not so high (transferability). Research on the instability of international trade and its influencing factors was initiated by the book by Coppock (1977). In "International trade Instability", he argued that since the purpose of economic activity is to use changeable resources, therefore, all changes cannot be deemed undesirable and unwanted. For this reason, he believed that good instability and problematic instability should be distinguished. He argues that instability should not be defined as any deviation from a constant direction; but it is considered as deviations higher than normal which Normal values are usually the trend line values. According to his claim, it is clear that a precise definition of the instability requires judgment about words like extravagance, dissipation and normality which are used by most researchers about issues related to instability.

3. Spatial Model Specification

Generally, there are three methods to consider spatial effects through spatial lag operation on the dependent, independent variables and the error terms (Anselin, 1988; LeSage, 2009). *General Nesting Spatial Model (GNSM)* that imposes spatial lag on the dependent, independent and error term variables are as follows:

$$y = \rho Wy + \alpha I_n + X\beta + WX\gamma + \varepsilon;$$
$$\varepsilon = \theta W\varepsilon + u \quad (1)$$

Where ρ is auto-regressive spatial coefficient, γ similar to β representing a $K \times 1$ vector of independent variable parameters and W is a $N \times N$ *spatial* matrix. In this equation Wy refers to the endogenous interactions among the dependent variables, WX refers to the interactions exogenous among the independent variables and $W\varepsilon$ refers to the interactions exogenous among the independent variables in different units (Elhorst, 2014). Figure 1, summarizes a family of eight linear spatial econometric models include: SAR (Spatial lag model), SLX, SEM (Spatial Error Model), SDM (Spatial Durbin Model), SDEM (Spatial Error Durbin Model), SAC and GNSM. Each model to the right of the GNSM model can be obtained from that model by imposing restrictions on one or more of its parameters. The kinds of restrictions are reported alongside the arrows in Figure 1.

These models can be defined in the form of combined panel data models (for more details see Anselin, 2001; Anselin et al., 2008; Elhorst, 2001; 2003).

In order to investigate the factors affecting international trade instability using the logarithmic form of data and Panel model of SAR, the following model is specified:

$$y = pWy + \alpha I_n + X\beta + u \quad (2)$$

Where y is trade instability index, X refers to the matrix of independent variables, W refers to the spatial effects.

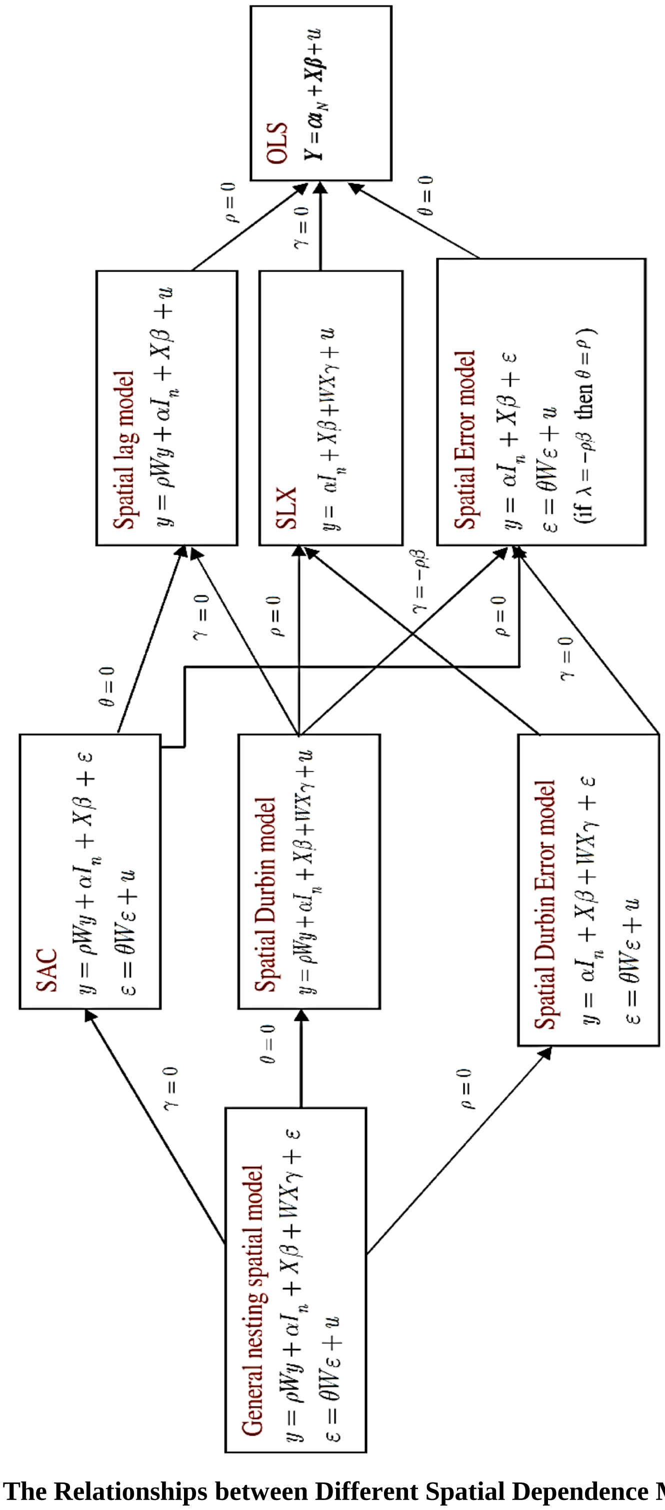

Figure1: The Relationships between Different Spatial Dependence Models for

Cross-Section Data (Halleck Vega S and Elhorst JP, 2012)

4. Methodology

4.1 Data Description and Variables

In this study, 34 major countries in world international trade, including Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Finland, France, Germany, India, Iran, Indonesia, Italy, Japan, Korea, Malaysia, Mexico, Netherlands, New Zealand, Norway, Peru, Philippines, South Africa, Saudi Arabia, Singapore, Spain, Sweden, Switzerland, Thailand, Turkey, Britain and US which have more than 75 percent of world international trade and period from 1990-2012. In figure2 and figure3 is shown the share of international trade and maritime transport and geographical distribution of selected countries, respectively.

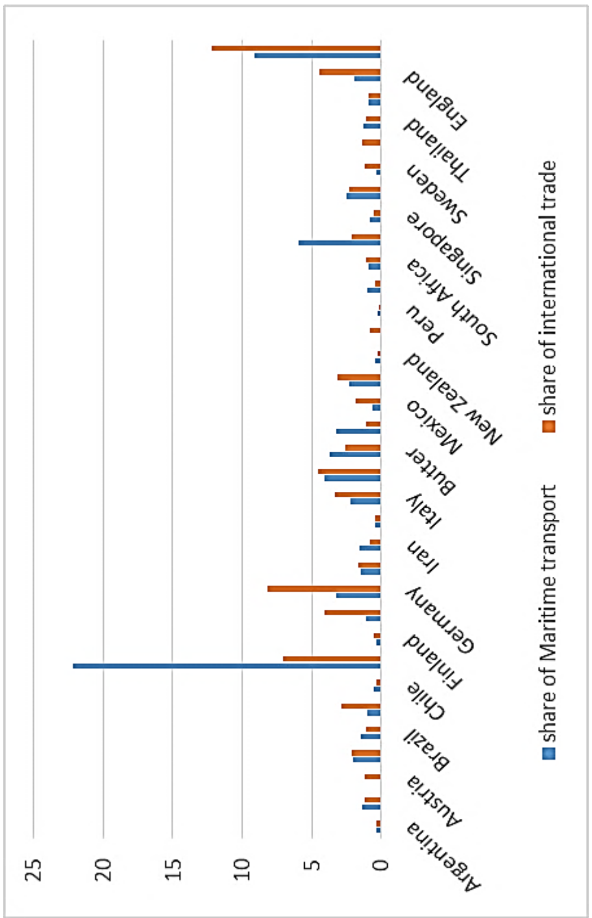

Figure 2: The Share of International Trade and Maritime Transport in

Selected Countries

Figure 3: Geographical Distribution of Selected Countries

Given the literature review and theoretical framework, the data used for the model are presented as follows:

- Total value of exports in current local currency: (clx);
- Total value of imports in current local currency: (clm);
- Total value of GDP in current local currency: (cly);
- Population in terms of persons: (pop);
- Nominal bilateral dollar exchange rate: (nex)
- Consumer price index in constant prices in the year 2000: (cpi);
- Share of exports of agricultural and foods of total exports: (sfx);
- Share of raw and intermediate food import of total import: (srm);
- The marine transportation on the basis of the TEU (teu);
- International trade matrix includes exports and imports (c. i. f.): (Wt);
- Geographical distance matrix as the spatial distance between the two countries in terms of miles: (Wd).

Required data of clx, clm, cly, pop, nex, cpi, sfx, srx, srm was collected from the World Bank and the international trade matrix data IFS DOT statistics were used. If a variable was with missing data, were modified based on the data interpolation method by using Eviews 7 Software. Thus, variables used in the model estimation are defined as follows:

Dependent Variable

- Total value of international trade in current US$: $cust = \frac{clx + clm}{nex}$;

Independent Variables

- Production variables:

1. Growth rate of GDP in constant local currency: $gr = d\log(\frac{cly}{cpi})$;
2. Total value of GDP in current US$:

$cusy = \frac{cly}{nex}$;

3. GDP Per capita in current US$ per persons: $cusyp = \frac{cusy}{pop}$;

- Commodity concentration indexes:

1. Share of raw and intermediate foods import of total import: srm;
2. Share of exports of agricultural and foods of total exports: sfx;

- Geographic concentration index based on the Gini coefficient Hirschman (1864): $geo_i = \sqrt{\sum_{\substack{i=1 \\ j=1}}^{n} (w_{ij})^2}, i, j = 1,...,n$, where $w_{ij} = \frac{T_{ij}}{\sum_{\substack{i=1 \\ j=1}}^{n} T_{ij}}$ share of international trade country i with country j and T_{ij} is international trade rate of country i with country j; is computed through international trade matrix
- Nominal bilateral dollar exchange rate: (nex);
- Consumer price index in constant prices in the year 2000: (cpi);
- The marine transportation on the basis of the TEU (*teu*);

Spatial Weight Matrix

In this study, the geographic distance and bilateral international trade matrix have been used to survey the spatial effects. Since, in the international trade it is possible for the two countries with far geographic distances, there is a lot of international trade, or two countries with little geographic distance or neighbor countries have not any international trade with each other. For this purpose, using standardized geographic distance weight matrix (SWd) and multiplied by the international trade matrix (Wt), adjusted matrix-international trade based on geographic distance (Wtd) will be obtained. This adjustment is applied as follows:

$$wtd_{ij} = wt_{ij} \cdot \frac{d_{ij}}{\sum d_{ij}} \qquad (3)$$

Where wtd_{ij} is an element of row i and column j in adjusted an international trade matrix based on row-standardized weighted matrix of geographical distance, wt_{ij} by row i and column j is an international trade-weighted matrix and $\frac{d_{ij}}{\sum d_{ij}}$ is an element in row i and column j in the row-standardized weighted matrix of geographical distance.

4.2 Instability Index

Currently, the identification and selection of appropriate methods of analysis and smoothing methods are difficult. In recent years, the importance of the choice of economic planning and forecasting has caused time series analysis methods and linear development within the framework of filters such as Hodrick-Prescott Filter (1997), Band-Pass Filter (Baxter and King, 1999) and wavelet to be more considered. Theoretical studies showed that the wavelet method is suitable mathematical tool for signal analysis. According to Ramsey (1999, 2002), it is a suitable tool for investigating Business Cycle. The major characteristics of filtering method are simple application and precise time series analysis. Based on analyses Fourier, wavelet method can be analyzed in the form of time series analysis in variant time scale or different horizon (Kim et al., 2008). While, in other statistical methods, time domain and frequency domain are considered for financial time series analysis. This characteristic has caused wavelet analysis of time frequency in economic and financial time series modeling to be used broadly (Gencay, Selcuck and Whitcher, 2003). Application of wavelet analysis is associated with a lot of problems one of which is selection of the appropriate type and length. Fernandez (2006) showed that the best wavelet analysis used is orthogonal wavelets; the most important of which are Haar, Daubechies, Symmelets, Coiflets and Biorthogonal. In this study, Biorthogonal wavelet is used.

It is shown with $biorNr.Nd$. In contrast with other wavelets which are orthogonal and single wavelets, this wavelet is biorthogonal. In this wavelet, Nr *refers to the first wavelet and* Nd refers to the second wavelet. Having investigated wavelets and different wavelengths, the third level of the wavelet $bior2.2$ will be selected. It will be based on $MATLAB$, version of $R2013a$; first, the logarithm is taken from non-spatial independent and dependent variables; and then, by using the wavelet, $bior2.2$ will be decomposed. In Figure 4, for example, shows the result of the series decomposition of total value of international trade (CUST). Other variables have been analyzed accordingly. Also, in this research second level selected.

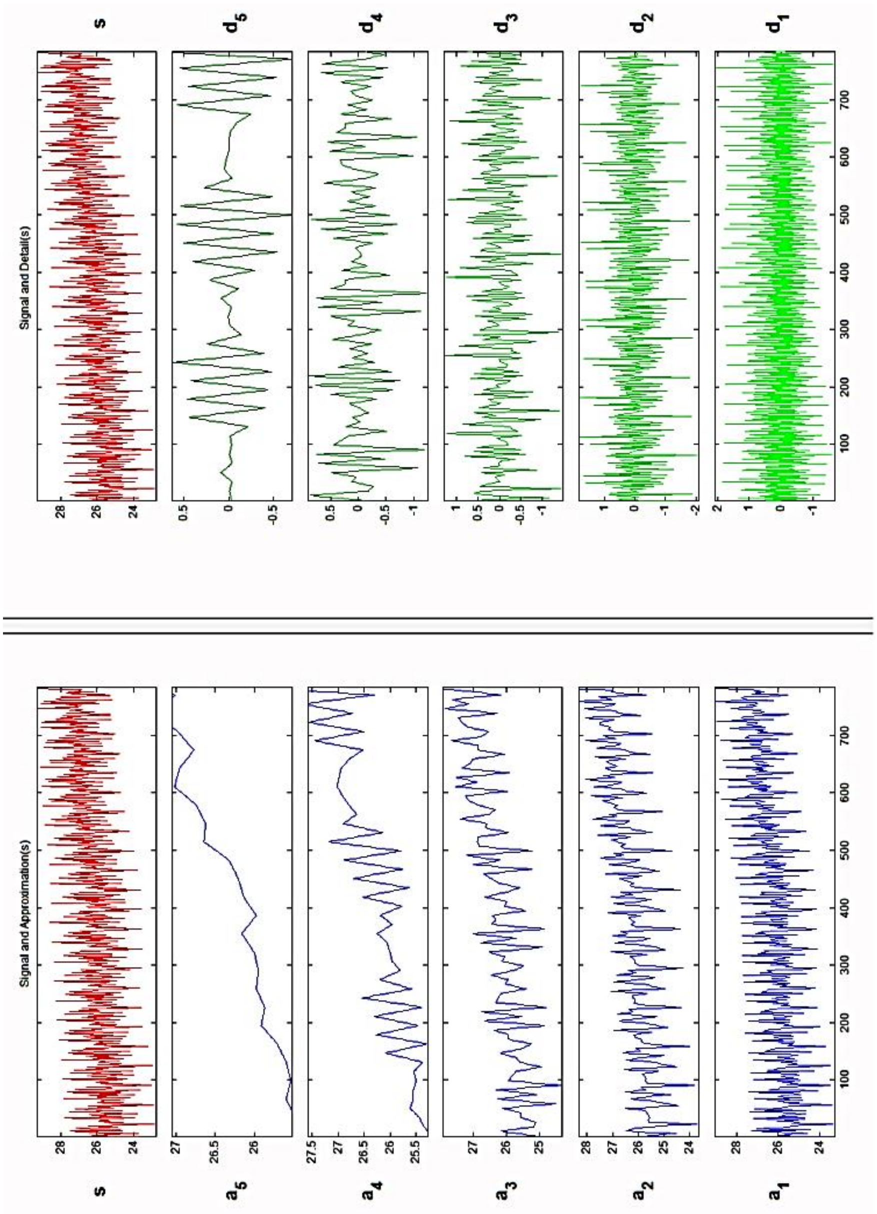

Figure 4: Results of Series Decomposition of "CUST" for Five Level of Bior2.2 Wavelet

5. Empirical Analysis

5.1 Stationary Test

In spatial models, in addition to variables of model, the problem of unit root is also entered on spatial operations which affect the dependent and independent variables. According to the results of study done by Kelejian and Prucha (1998; 1999), Lee (2004) and LeSage and Pace (2009: 88–89), if variables are static and Spatial weight matrix is symmetric, spatial variable is not unit root and with the asymmetric spatial weight matrix, spatial variable will be stable provided that sum rows and columns of the Spatial matrix is close together or when the N (regions) tends to infinity, they tends to be closer together, or in other words, are converging.

Given that the matrix used in this study is a weighted matrix of bilateral international trade classified in asymmetric matrices. In this study, using spatial matrix multiplication in independent and dependent variables through software MATLAB, first, spatial variable is created and then using validity test through *Levin and Lin* (LL) (2002), *Breitung* (B) (2000), *Im, Pesaran, Shin* (IPS) (2003) and *Augmented Dickey-Fuller* (ADF) and *Phillips-Perron* (PP) by $Eviews7$, stationary test is taken from non-spatial variables. Also, determining the optimal lag length automatically based on statistics Schwartz Info Criterion (SIC) is carried out. Stationary test results for relationship with individual intercept and the trend in the level are shown in Table 1.

Table 1: Results of Stationary Tests of Model Variables

Variable	LL	B	IPS	ADF	PP
$dlcust2$	37.7* (1.00)	6.2* (1.00)	-5.4 (0.00)	407.1 (0.00)	5103.5 (0.00)
$dlcpi2$	-16.8 (0.00)	-3.04 (0.00)	-20.3 (0.00)	555.6 (0.00)	2260.8 (0.00)
$dlcusy2$	-10.2 (0.00)	1.99* (0.97)	-21.4 (0.00)	1101.7 (0.00)	5111.4 (0.00)
$dlcusyp2$	-85.9 (0.00)	-1.1* (0.13)	-43.1 (0.00)	934.4 (0.00)	5481.2 (0.00)
dlgeo2	10.9* (1.00)	1.1* (0.9)	-9.4 (0.00)	558.7 (0.00)	2531.5 (0.00)
dlnex2	-24.3 (0.00)	0.65* (0.74)	-33.2 (0.00)	965.8 (0.00)	5548.3 (0.00)
$dlsfx2$	-121.6 (0.00)	-2.3 (0.01)	-57.1 (0.00)	1158.3 (0.00)	6224.1 (0.00)

Variable	**LL**	**B**	**IPS**	**ADF**	**PP**
$dlsrm2$	1.4* (0.91)	-2.84 (0.00)	-10.9 (0.00)	475.5 (0.00)	1625.1 (0.00)
$dlteu2$	-35.5 (0.00)	-2.85 (0.02)	-34.9 (0.00)	1354.7 (0.00)	3281.9 (0.00)

Source: Research results.

As can be seen from the above results, the variables are integrated at the zero level and so there is no unit root problem.

5.2 Verify the Existence or Non-Existence of Spatial Effects

Lagrange Multiplier test (LM) and Robust Lagrange Multiplier code is defined by Elhorst (2003) for this purpose. Based on these two tests, the null hypothesis that the absence of spatial effects on the dependent variable and the error terms will be tested. If the null hypothesis is rejected, the model based on the existence of spatial effects is confirmed. Table 4 presents the results of investigation this test on a different panel OLS including *Pooled Model*, *Spatial Fixed Effect*, *Time Period Fixed Effect*, *Spatial and Time period Fixed Effect bias correction* and *Time period Fixed Effect and Spatial Random effect*. As is clear from the Table 4, the results, although different in details, but, thoroughly confirm presence of spatial effect of the dependent variable.

5.3 Fixed-Effect Spatial Models Selection

In this step, the estimation and diagnostic test Fixed-Effect Spatial Panel Model with Maximum Likelihood (ML) estimator is performed. This step has been carried out using Elhorst's (2003) codes, models of *SAR*,*SEM* ,*SDM* ,*SDEM* and the Debarsy and Arthur's (2010) codes, SAC model and use of this code and replacing matrix [X WX] Instead X, Specification of MATLAB codes for models of *SLX* ,*GNSM* by the author . Then, Using Lagrange multiplier (LM) test and Likelihood Ratio (LR), best type of Spatial Panel Model is selected. In this step based on the hypotheses that test combined spatial model in mutually put together manner, the model type is selected. Table 2, shows the results of this test hypotheses.

Based on the results shown above, SAR model is confirmed. Based on results, the neighborhood spatial effects on variables are confirmed. The negative spatial dependent and error coefficients are estimated. So that, an increase by one percent in international trade instability and unknown instability in neighboring countries causes 2.1, 0.55 percent increase in international trade instability of each country in the reverse direction, respectively.

5.3 Estimation and Selection of Models

Table 5 shows the estimation results of panel SAR with Maximum Likelihood (ML) estimator. After estimation and before interpretation of coefficients, diagnostic test is performed. Using Lagrange multiplier test and Hausman test, type of fixed effect and random effect model is selected. In this step based on the hypotheses that test combined spatial model in mutually puts together manner, the model type is selected. Table 3, shows the results of this test hypotheses.

Table 2: Results of Hypotheses Tests for Determining the Type of Spatial Panel Models

Hypothesis	$H_0 \vee H_1$	LR	LM	Result
1	$OLS \vee SEM$	$LR = 16.55$, $prob = 0.00$	$LM = 9.46$, $prob = 0.00$	SEM
2	$OLS \vee SAR$	$LR = 38.55$, $prob = 0.00$	$LM = 30.88$, $prob = 0.00$	SAR
3	$OLS \vee SAC$	$LR = 46.46$, $prob = 0.00$	$LM = 31.58$, $prob = 0.00$	SAC
4	$SEM \vee SAC$	$LR = 29.92$, $prob = 0.00$	$LM = 22.39$, $prob = 0.00$	SAC
5	$SAR \vee SAC$	$LR = 0.61$, $prob = 0.4$	$LM = 2.8$, $prob = 0.1$	SAR
6	$SLX \vee SDEM$	$LR = 12.3$, $prob = 0.00$	$LM = 5.33$, $prob = 0.02$	$SDEM$
7	$SLX \vee SDM$	$LR = 14.3$, $prob = 0.00$	$LM = 7.56$, $prob = 0.01$	SDM
8	$SLX \vee GNSM$	$LR = 40.01$, $prob = 0.00$	$LM = 9.82$, $prob = 0.01$	$GNSM$

Hypothesis	$H_0 \vee H_1$	LR	LM	Result
9	$SEM \vee SDEM$	$LR = 52.92,$ $prob = 0.00$	$-----$	$SDEM$
10	$SDEM \vee GNSM$	$LR = 27.71,$ $prob = 0.00$	$LM = 90.05,$ $prob = 0.00$	$GNSM$
11	$SEM \vee SDM$	$LR = 55.04,$ $prob = 0.00$	$-----$	SDM
12	$SAR \vee SDM$	$LR = 0.72,$ $prob = 0.29$	$-----$	SAR
13	$SDM \vee GNSM$	$LR = 0.69,$ $prob = 0.21$	$LM = 0.32,$ $prob = 0.6$	SDM
14	$SAC \vee GNSM$	$LR = 0.42,$ $prob = 0.68$	$-----$	SAC

Source: Research results.

Table 3: Results of Hypothesis Tests for Determining the Fixed or Random Effects Models

Hypothesis	$H_0 \vee H_1$	LR	LM	Result
1	$Pooled \vee SFE$	$LR = 893,$ $prob = 0.00$	$-----$	SFE
2	$Pooled \vee TFE$	$LR = -7.3,$ $prob = 1.00$	$-----$	$Pooled$
3	$SFE \vee STFE$	$LR = -0.96,$ $prob = 1.00$	$-----$	SFE
4	$TFE \vee STFE$	$LR = 899,$ $prob = 0.00$	$-----$	$STFE$
5	$Pooled \vee STFE$	$LR = 892,$ $prob = 0.00$	$-----$	$Pooled$

Source: Research results.

Table 4: Results of LM and Robust LM of Various Panel SAR Models

Test	Model	Pooled	Spatial Fixed Effect	Time Peried Fixed Effect	Spatial and Time period Fixed Effect bias correction	Time Peried Fixed Effect Spatial Random effect
Spatial	none	Fixed Effect	none	Fixed Effect	none	Random effect
Time period	none	none	Fixed Effect	Fixed Effect	Random effect	Fixed Effect
LM spatial lag (prob)	12.5 (0.00)	32.3 (0.00)	7.7 (0.00)	32.7 (0.00)	12.3 (0.00)	12.2 (0.00)
Robust LM spatial lag (prob)	5.3 (0.02)	23.1 (0.00)	1.8 (0.18)	15.1 (0.00)	5.02 (0.02)	10.7 (0.00)
LM spatial error (prob)	10.5 (0.00)	9.9 (0.00)	12.5 (0.00)	17.7 (0.00)	10.5 (0.00)	11.8 (0.00)
Robust LM spatial error (prob)	3.4 (0.06)	0.7* (0.4)	6.6 (0.01)	0.3* (0.9)	3.4 (0.06)	4.3 (0.06)

Source: Research results.

Based on the results shown above, spatial fixed effect model is confirmed. Based on the results shown in Table 5, the coefficient of spatial of neighboring is estimated negative and Low elasticity. In other words, one percent increase in international trade fluctuations in neighboring countries could increase instability in the opposite direction in the own countries. This means that sudden 100 percent increase in international trade in neighboring countries will reduce sudden 38 percent of trading in own country.

Table 5: Estimation Results of Panel SAR

Model	Pooled	Spatial Fixed Effect	Time Period Fixed Effect	Spatial and Time period Fixed Effect bias correction	Time Period Fixed Effect Spatial Random effect
W *$dlcust2$ (*prob*)	−0.24 (0.00)	−0.38 (0.00)	−0.27 (0.00)	−0.69 (0.00)	−0.52 (0.00)
$dlcpi2$ (*prob*)	0.005* (0.7)	0.08 (0.00)	0.005* (0.7)	0.08 (0.00)	0.07 (0.00)
$dlcusy2$ (*prob*)	0.6 (0.00)	0.68 (0.00)	0.6 (0.00)	0.67 (0.00)	0.68 (0.00)
$dlcusyp2$ (*prob*)	0.09 (0.00)	−0.11 (0.00)	0.09 (0.00)	−0.12 (0.00)	− 0.1 (0.00)
$dlgeo2$ (*prob*)	0.96 (0.00)	1.02 (0.00)	0.96 (0.00)	1.02 (0.00)	0.99 (0.00)
$dlnex2$ (*prob*)	−0.003* (0.6)	−0.09 (0.00)	−0.003* (0.6)	−0.09 (0.00)	−0.08 (0.00)
$dlsfx2$ (*prob*)	−0.21 (0.00)	−0.18 (0.00)	−0.21 (0.00)	−0.18 (0.00)	−0.19 (0.00)
$dlsrm2$ (*prob*)	−0.24 (0.00)	0.07 (0.01)	−0.24 (0.00)	0.07 (0.01)	0.06 (0.03)
$dlteu2$ (*prob*)	0.14 (0.00)	0.1 (0.00)	0.14 (0.00)	0.1 (0.00)	0.1 (0.00)
R^2	0.94	0.98	0.94	0.98	0.98
σ^2	0.02	0.001	0.02	0.001	0.001
$LogL$	424	870	420	870	870

Source: Research results.

Notes: For above estimated coefficients * indicates statistically significant of coefficient up to 1% percent level, ** up to 5% level and *** up to 10%.

5.4 Direct, Indirect and Total Effects

OLS regression parameters have a straightforward interpretation of the partial derivative of the dependent variable to an explanatory variable. In other word, the total impact of the estimated parameters can be interpreted. However, the interpretation of the spatial regression coefficients shown above, based on the estimated parameters may not happen; rather, it is done by examining the direct and indirect effects (spillovers). Direct and indirect effects (spillovers) of Spatial Fixed Effects of SAR and OLS Cross-Section Fixed Effects (for comparison) are shown in Table 6.

Table 6: Direct and Indirect (Spillovers) Spatial Effects

Variable		Dirrect		Indirrect		Total SAR		OLS
$dlcpi2$ (prob)	Min Max	0.08 (0.00)	0.06 0.1	−0.02 (0.00)	-0.03 -0.02	0.06 (0.00)	0.05 0.07	0.08 (0.00)
$dlcusy2$ (prob)	Min Max	0.69 (0.00)	0.66 0.71	−0.19 (0.00)	-0.24 -0.14	0.5 (0.00)	0.45 0.55	0.68 (0.00)
$dlcusyp2$ (prob)	Min Max	−0.12 (0.00)	-0.14 -0.09	0.03 (0.00)	0.02 0.04	−0.08 (0.00)	-1.0 -0.07	− 0.1 (0.00)
$dlgeo2$ (prob)	Min Max	1.02 (0.00)	0.91 1.14	−0.28 (0.00)	-0.36 -0.21	0.74 (0.00)	0.63 0.86	1.05 (0.00)
$dlnex2$ (prob)	Min Max	−0.09 (0.00)	-0.1 -0.08	0.02 (0.00)	0.017 0.03	−0.06 (0.00)	-0.08 -0.05	−0.09 (0.00)
$dlsfx2$ (prob)	Min Max	−0.18 (0.00)	-0.2 -0.16	0.05 (0.00)	0.04 0.06	−0.13 (0.00)	-0.15 -0.11	−0.18 (0.00)
$dlsrm2$ (prob)	Min Max	0.07 (0.01)	0.02 0.12	−0.02 (0.01)	-0.03 -0.01	0.05 (0.01)	0.01 0.09	0.07 (0.01)
$dlteu2$ (prob)	Min Max	0.1 (0.00)	0.09 0.12	−0.03 (0.00)	-0.04 -0.02	0.08 (0.00)	0.06 0.09	0.11 (0.00)

Source: Research Results.

The estimation results of direct and indirect effects are highly significant. Based on the results elasticity of the instability of international trade relative to instability of the domestic price index arising from own countries directly and neighboring countries indirectly is low; the rate is calculated 0.08 and -0.02, respectively which its total conclusion is instability of 0.06 percent of international trade. Elasticity of the instability of international trade relative to the instability of GDP arising from neighboring countries (spillovers) is low and equal to -0.2 in the opposite direction and arising from own countries (direct effect) is low and equal to 0.69 which its total conclusion is instability of 0.5 percent of international trade. Elasticity of international trade instability relative to the instability of GDP per capita arising from own countries directly and neighboring country indirectly is low; the rate is calculated -0.12 and 0.03, respectively, which its total conclusion is instability of 0.09 percent of international trade. Elasticity of international trade instability relative to the instability of geographical concentration arising from own countries directly and neighboring country indirectly is low; the rate is calculated 1.02 and -0.28, respectively, which its total conclusion is instability of 0.74 percent of international trade. Elasticity of international trade instability relative to the instability of nominal exchange rate arising from own countries directly and neighboring country indirectly is low; the rate is calculated -0.09 and 0.02, respectively, which its total conclusion is instability of 0.07 percent of international trade. Elasticity of the instability of international trade relative to instability of the foods and agricultural exports arising from neighboring countries (spillovers) is low and equal to -0. 18 and arising from own countries (direct effect) are low and equal to 0.05, which its total conclusion is instability of 0.13 percent of international trade. Elasticity of the instability of international trade relative to the instability of imports of intermediate and raw foods arising from own countries directly and neighboring country indirectly is low; the rate is calculated 0.07 and -0.02, respectively, which its total conclusion is instability of 0.05 percent of world international trade. Finally, elasticity of the instability of international trade relative to instability of the maritime transportation arising from own countries directly and neighboring countries indirectly is low; the rate is calculated 0.1 and -0.03, respectively, which its total conclusion is instability of 0.07 percent of international trade.

6. Conclusion

The main objective of this study is to evaluate the impact of maritime transportation instability on international trade instability based on wavelet smoothing and spatial panel data econometric method. The results showed that the spatial effects have an impact on international trade instability. So that one percent increase of international trade fluctuations in neighboring countries could increase instability of 0.38 percent of own countries in the opposite direction. In other words, sudden hundred percent increase in international trade in the neighboring countries will reduce 38 percent of trading in own countries. Evaluation and interpretation of the results of direct elasticity of international trade instability showed that instability in domestic prices, GDP, the import share of total imports of intermediate and raw foods, geographic concentration and maritime transportation of the own country will cause instability of international trade in the opposite direction; and other variables showed a direct effect on international trade instability. However, the marine transport on international trade fluctuations did not have a significant impact and geographic concentration is the most important variable of instability on international trade.

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