Jamil, M. N., Shahzad, K. and Jabeen, A. (2023). General Diagnostic test for Sustainable Economic Growth Multi Dependent Panels: A Study of Pak-US Trade. *Bulletin of Business and Economics*,12(2), 332-338. https://doi.org/10.61506/01.00006

Bulletin of Business and Economics
ISSN - 2409 - 9368

GENERAL DIAGNOSTIC TEST FOR SUSTAINABLE ECONOMIC GROWTH MULTI DEPENDENT PANELS: A STUDY OF PAK-US TRADE

MUHAMMAD NAVEED JAMIL[1], KHADIJA SHAHZAD[2], ALIYA JABEEN[3]

ABSTRACT

The basic purpose of this study to General Diagnostic test for Sustainable Economic Growth Multi Dependent Panels of Cross Section. The two sample models are using "USA import from Pakistan impact on USA economy" and "Pakistan export to USA impact on Pakistan economy" with multi macroeconomic dependent variables of each country for the period of 2012 to 2021 and examine through a new General Diagnostic test of Cross-section diagnostic test (CSDT) that highly recommended for future examination of research data. The Results showing the high impact "Import on US Macroeconomic variables" and "Export on Pakistan Macroeconomic variables" that influencing the country economy. The Cross-section diagnostic test (CSDT) result also indicates each macroeconomic dependent variable of a country highly influenced by import and export. Like Pakistan face balance of payment issue and export helping indicator and USA shortage of agricultural product, dairy and natural resources production, import strengthen the usage (meet the need), standard living and economy. Research implications are very clear import and export of a country is highly significant that meet the need of financial and usage of a country. This study has two main recommendations. First, strongly recommends for Policy maker more focus on exports with the help of country resources and meet the need of country. Second, the study is strongly recommended to research institution, and research scholar the new General Diagnostic test Multi Dependent Panels of Cross Section (for Sustainable Economic Growth) is suggested to use for future examination of research data.

KEYWORDS: General Diagnostic test, Cross-Section Diagnostic Test (CSDT), Pak-US Economy

1. INTRODUCTION

General Diagnostic test for Sustainable Economic Growth Multi Dependent Panels of Cross Section are highly significance for research and academia. Panel data models (disturbances) assumed as for cross sectional independent. True panels with dimension of cross section (large=N); if panels was N is small between 10 or less and time dimension for panel was large correlation error term, efficiency would be increase when disturbance term in different equation with high correlation, used the unrelated regression equation (SURE) that framework developed by (Zellner & Huang, 1962). N fixed as T time series model, including log-likelihood-Ratio test used to examine the results, common known example of Lagrange Multiplier (LM) test base on average square pair correlation (residuals), if N is large then may other estimation techniques applied suggested by (T. Breusch & A. Pagan, 1980). Cross Section examination was based on connection or spatial matrix i.e. (i, j) elements pre-rules of connection matrix. Wii was 1 = I = j otherwise zero by literature support of (Moran, 1948a, 1948b), (Cliff & Ord, 1975), (Burridge, 1980, 1981), (De Jong et al., 1984), (Anselin, 1988a, 2001b). The small properties investigation Lagrange multiplier test of Breusch and Pagan was using Monte Carlo experiments and quite robust unit roots and break structural (Pesaran, 2021). Cross-sectional dependence model error was applicable in variety panel data models that need to de diagnose (Hashem, 2021). Panel date continuous time series was process multi state models was Markov assumption based, but misclassified or observed through a noisy marker (Jackson, 2011).

Spatial matrix is not useful in mostly economic causes where natural metric not spaced. This paper is diagnostic a test which not required pre specification of connection matrix and most appropriate for variety of panel models and useful stationary dynamic and panel data of heterogeneous unit-root for T short run and N for long run. Study proposed test on the basic of average of pairs (correlation coefficients of OLS) regression panel individual residuals and robustness; variable of single or multiple breaks in slope coefficients i.e. sustainability, mean and variances error. Symmetrically, asymmetrically and asymptotic distribution is establishing under Null hypothesis. Where priori order can be disturbed with spatial observations and spatial connection matrices purposed with generalizations. P order measure contiguous layers of neighbours; i cross section unit and reduce one time period N-1. Monte Carlo experiments (LM Test) is for small sample properties, while its for satisfactory power and correct size even weak degree for cross section study; T≥10 not effecting by multi-breaks, so means conditions unchanged over time. Estimation panel regression data without interaction was being developed between cross-session and spatial units. Common factor and spatial weights matrix were spatial dependence unobserved, and their connection

[1] Corresponding Author, Institute of Business Administration, Khwaja Fareed University of Engineering & Information Technology, Rahim Yar Khan, Pakistan, mnaveedknp@gmail.com
2 MS Leadership & Management, Islamia University Bahawalpur, Pakistan
3 Department of Economics and finance, International Islamic University Islamabad, Pakistan

with assumption as exchangeability (Bhattacharjee & Holly, 2011). Moreover literature support can get heterogeneous dynamic panels and structural breaks for robustness. This study Generate a Diagnostic test further referred to as Cross-section diagnostic test (CSDT) considering future for multi dependent panel data.

2. LITERATURE REVIEW OF EMPIRICAL MODELS AND APPROACHES

Empirical investigation on error panel model was weakly cross-sectionals dependent, mainly true panel with large cross-sectional dimension (N) and (T) for time cross-sectional dimensions (Zellner, 1962). Commonly log-likelihood ratio tests used in past decades, Lagrange multiplier test introduced by(T. S. Breusch & A. R. Pagan, 1980), it rely on average of squared pair-wise correlation of residuals. Empirical literature furthermore explore the spatial weight matrix by (Anselin, 1988b, 2001a; Anselin & Bera, 1998; Cliff & Ord, 1981; Getis, 1995; Haining, 2003; Moran, 1948a). The issue still and not adequately addressed, further studies as on CD test joint asymptotic with N and T, power property and large penal (Pesaran, 2006, 2015), error correction (Pesaran et al., 2004), LM test error correction (Pesaran et al., 2008), Spatial error correction (Baltagi et al., 2003), two way error component data (Mao, 2018), latest study on error cross sectional dependence by (Pesaran, 2021), CD test still not fulfill the error of cross sectional dependency, need to propose new diagnostic test for cross sectional dependency world multi countries data output. Study suggests a new test "Cross-section diagnostic test (CSDT)" for panel data, so long as but implement there are no major asymmetries in the error distribution.

2.1. BASIC LINEAR EQUATION

$$Y = a + \beta X + \mathcal{E}$$
$$Y_{it} = a_i + \beta_i X_{it} + \delta d + \mathcal{E}_t$$

Y is dependent variable the predate values, a intercept, ß Regression co-efficient, X is independent variable. "i" is for cross section and "t" is for time series dimension. Dummy as d and Residual means is the difference between predict and observed values.

Empirically, there were two approaches commonly used to test the panel cross section dependent (1) Moran approach of Spatial Correlation Pioneered 1948 (2) Breusch and Pagan approach of Lagrange Multiplier 1980.

2.2. Spatial Correlation Pioneered Test by Moran 1948

$$\mu_{it} = \lambda \left(\sum_{j=1}^{N} W_{ij}\, \mu_{it} \right) + \sigma_i \mathcal{E}_{it}$$

Where each is $\mathcal{E}_{it} = \mu_{it} = 0, 1$; "i" is for the cross section and "t" is for the time series dimension, W^{ij}denoted for weights spatial and pre assumed and specified. Error term is examined through null hypothesis of$\lambda = 0$. W measure in empirical literature supported (Anselin, 2009, 2019; Carrer et al., 2021; Getis, 2008, 2010; Marton, 2015; Pesaran, 2021; Schwarz & Mount, 2005).

2.3. LAGRANGE MULTIPLIER (LM) APPROACH OF BREUSCH & PAGAN 1980

LM approach SURE as N for fixed and T for time, LM test base on null hypothesis cross sectional is zero (Anselin, 1988a; Baltagi et al., 2012; Baltagi & Li, 1990; T. S. Breusch & A. R. Pagan, 1980; Buse, 1982; Engle, 1982; Pesaran, 1981).

$$(CD)\iota_{\mathrm{m}} = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} P^{\wedge 2}{}_{ij}$$

When residuals is estimate pair wise correlation for P_ij sample.

$$\hat{P_{ij}} = \hat{P_{ji}} = \frac{\sum_{t=1}^{T} e_{it}\, e_{jt}}{(\sum_{t=1}^{T} e_{it}^2)½ \left(\sum_{t=1}^{T} e_{jt}^2\right) ½}$$

2.4. MONTE CARLO

$$Y_{it} = \mu_i\,(1 - \beta_i) + \beta_i y_{it} + \mu_{it}$$
$$u_{it} = \lambda_i f_t + e_{it} \quad \text{I = 1, 2 N; t = 1, 2}$$

The errors of idiosyncratic e_{it} were generated through (1) Normal error $e_{it} - \text{iidN}(0,1)$ and (2) Chi Square error $e_{it} - \text{iidX}$ with t distribution with 4 degree of freedom, but results were in-distinguishable due to normal errors based (Hammersley, 2013; James, 1980; Metropolis & Ulam, 1949; Mooney, 1997).

2.5. M. HASHEM PESARAN MODEL 2004

$$Y_{it} = a_i + \beta_i X_{it} + \mu_{it}$$

Where $_i$ is for cross section and t time series dimension, K x 1 vector of X_{it} is observed time variation regressors, a_i is for slop coefficient and individual intercepts, $ß_i$ use for compact set and variation of i (Pesaran et al., 2004; Pesaran & Zaffaroni, 2004).

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} P^{\wedge 2}{}_{ij} \right)$$

There was cross section dependence with small reasonable and properties which not depend on matrix of spatial weight. Where N is for large and T for small and pair wise correlation coefficients; not used squares of LM test.

2.6. GARCH AND GJR MODEL

$$\sigma_t^2 = k + \sum_{i=1}^{P} G_i\, \sigma_{t-1}^2 + \sum_{j=1}^{Q} A_j\, \mathcal{E}_t^2 + \sum_{j=1}^{Q} L_j\, S_{t-j} \mathcal{E}_{t-j}^2$$

EGarch Model

$$y_t = C + \sum_{i=1}^{R} \phi_{\text{i}}\, y_{t-1} + \mathcal{E}_t \sum_{j=1}^{M} \theta_j \mathcal{E}_{t-j} + \sum_{k=1}^{N_x} \beta_k\, x\,(t,k)$$

Garch, GJR and EGarch Model useful Sustainable Economic Growth, stock return and time series estimation (Ali, 2013; Nugroho et al., 2019; Ramasamy & Munisamy, 2012; Wang, 2009).

2.7. A NEW TEST "CROSS-SECTION DIAGNOSTIC TEST (CSDT)" FOR PANEL DATA

There is considering the following Cross-section diagnostic test (CSDT) Model for future panel data.

$$Y_{it} = \beta_i X_{it} + \eta_i K_{it} + \mu_{it}$$

Where Y_{it} is denoted for Cross section dependent, "i" is for cross section and "t" is for time series dimension. X_{it} is a vector of explanatory variables, K_{it}, is a vector of dummies, the ß's and ꞃ's are parameters to be estimated, and each is $i = \mu_{\text{it}} = 0, \sigma 2$, stationary integrated order between 0 or 1 and unit roots integratedbetween1,1.

$$\mu_{it} = \lambda \left(\sum_{\text{j=1}}^{\text{N}} S^{ij} \mu_{it} \right) + \sigma_i \mathcal{E}_{it}$$

Where each is $\mathcal{E}_{\text{it}} = \mu_{\text{it}} = 0, 1$; "i" is for cross section and "t" is for time series dimension, W^{ij} denoted weights spatial and pre assumed and specified. Error term is examined through null hypothesis of $\lambda = 0$. S measure in empirical literature supported by (Cliff & Ord, 1975) and of $\lambda = 0$ suported by (Anselin, 1988a; Baltagi et al., 2003).

Assumption

(1) "μ_{it}" is serial independent and zero, $_{\text{i}}$ for disturbance $_{\text{t}}$ for time period.

(2) μ_{it} Null hypothesis $\mu_{\text{it}} = q_i e_{it}$, e_{it}iid-(0, 1)

(3) X_{it} is a vector of explanatory variables, K_{it}, is a vector of dummies, the ß's and ꞃ's are parameters to be estimated, all strictly exogenous.

Proof

There is proof through data examination and robustness of Cross-section diagnostic test (CSDT) of sustainable and validation of results.

$$a_{ir} = \mu_{iy} - \beta_{ir} \mu_{ix} r = 1, 2$$

Robustness of CSDT is useful single and even multiple break even structure in coefficients slopes and individual regressions of error variances.

3. DATA AND METHODOLOGY

The main purpose of study to diagnostic a new economic multi dependent Cross-section diagnostic test (CSDT) Model for this data was use to examine 121 product of US Imports from Pakistan panel data and 121 Pakistan Export to US panel data of 10 year since 2012 to 2021. Study examine the US Import from Pakistan impact on US economy macro dependent multi variables of US GDP, US GDP per Capita GDP, US Down Jones (NYSE) & the NASDAQ, US Gross Capital formation, US Inflation, US FDI, US Remittances, US trade and US Real effect of exchange rate, and same way Pakistan export to US impact on Pakistan economy Macro dependent multi variables of Pak GDP, Pak GDP per Capita GDP, Pakistan Stock Exchange, Pak Gross Capital formation, Pak Inflation, Pak FDI, Pak Remittances, Pak trade and Pak Real effect of exchange rate. Cross-section diagnostic test (CSDT) are used for examine panel data.

$$Y_{it} = \beta_i X_{it} + \eta_i K_{it} + \mu_{it}$$

Where Y_{it} is denoted for Cross section dependent, "i" is for cross section and "t" is for time series dimension. X_{it} is a vector of explanatory variables, K_{it}, is a vector of dummies, the ß's and ꞃ's are parameters to be estimated, and each is $i = \mu_{\text{it}} = 0, \sigma 2$, stationary integrated order between 0 or 1 and unit roots integratedbetween1,1. Robustness of CSDT is useful for validity and sustainable research result.

4. RESULT AND DISCUSSION

The above table of descriptive statistics of mean and standard deviation shows the potential of variables. Variables capacity influences on dependent and independent variables; Pakistan mean and standard deviation of GDP, GDP Per Capita, Inflation, Real exchange rate effect, and FDI, Remittances showing the potential of dependent variable. Inflation is very high values mean 30980 and Standard deviation 10927 most influence factor in context of Pakistan. US showing more potential on Stock exchange, Gross Capital Formation and Trade. Stock Exchange is leading and high valued mean 19229, standard deviation 5201.5 influencing factor for USA.

Table 1: Descriptive Statistic

Descriptive	USA					Pakistan				
	Mean	Median	Maxi.	Mini.	Std. Dev.	Mean	Median	Maxi.	Mini.	Std. Dev.
GDP	1.7	2.2	2.9	-3.6	1.8	3.8	4.5	5.8	0.5	1.8
GDP PER CAPITA	1.0	1.6	2.4	-4.0	1.7	1.6	2.4	3.7	-2.9	2.0
FDI	1.7	1.6	2.8	0.7	0.6	0.6	0.7	0.8	0.4	0.1
REMITTANCE	0.04	0.03	0.04	0.03	0.02	6.6	6.3	8.7	5.7	0.8
TRADE OF GDP	28.0	27.6	30.8	23.0	2.3	29.5	29.7	33.3	25.3	2.8
STOCK EXCHANGES	19229	17757	26890	11957	5201	15.4	15.3	17.3	14.1	0.9
GROSS CAPITAL FORMATION	20.6	20.7	21.2	19.1	0.6	7.2	7.4	11.9	2.5	3.1
INFLATION CONSUMER PRICE	1.7	1.7	3.2	0.1	0.8	30980	34777	45135	11825	10927
REAL EXCHANGE	105.7	104.9	116.2	95.0	8.1	107.5	105.4	121.5	97.2	8.1

Table 2: Regression of Multi Dependent Macro Economic variables

Variable	GDP Coefficient	GDP Per Capita Coefficient	FDI	Remittance	Trade Coefficient	GCF Coefficient	Inflation Coefficient	REER Coefficient	Stock exchange Coefficient
Us imports by Pakistan impact on USA economy macro variable	0.09*** 3.10	0.05** 2.28	9.81*** 4.39	2.08*** 4.68	0.01*** 4.67	0.01*** 4.69	0.01*** 4.29	0.06*** 4.68	0.01*** 4.54
Pakistan export to USA impact on Pakistan economy macro variable	0.02*** 4.18	0.08*** 2.74	3.74*** 4.60	3.88*** 4.67	0.01*** 4.68	0.09*** 4.68	0.04*** 4.36	0.06*** 4.67	0.01*** 4.41
R-squared	-0.82 -4.52	-0.33 -0.58	-7.88 -25.29	-159.5 -62.08	-144.41 -105.64	-1169.03 -323.28	-4.92 -5.43	-168.23 -175.04	-13.43 -7.90
Adjusted R-squared	-0.82 -4.52	-0.33 -0.58	-.7.88 -25.29	-159.5 -62.08	-144.41 -105.64	-1169.03 -323.28	-4.92 -5.43	-168.23 -175.04	19759.62 -7.90
S.E. of regression	2.44 4.21	2.07 2.55	1.77 0.64	0.03 6.62	27.82 29.41	20.39 15.31	1.88 7.79	105.06 106.89	472000000000 32601.18
Sum squared resid	7226.06 21481.18	4872.91 7893.34	3826.07 505.44	1.50 52983	935778.4 1045823	502888.3 283749.9	4283.45 73429.3	13345048 13815471	-13685 1280000000000
Log likelihood	-2798.1 -3457.2	-2559.7 -2851.5	-2413.4 1188.7	2329.36 -4003.4	-5740.6 -5807.8	-5364.9 -5018.6	-2481.7 -4200.8	-7348.4 -7369.3	-13685 -14290.86
Observations	1210	1210	1210	1210	1210	1210	1210	1210	1210
Sample Size	1 1210	1 1210	11210	11210	1 1210	1 1210	1 1210	1 1210	1 1210

There are two models of 121 import and 121 export products, 1210 observation and 11210 sample size each examine through Cross-section diagnostic test (CSDT) "USA import from Pakistan impact on USA economy" and "Pakistan export to USA impact on Pakistan economy" with multi macroeconomic dependent variables of each country. Result of both models is 1 percent level of significant and US import by Pakistan GDP 0.09***, GDP per Capita 0.05**, FDI 9.81***, Remittances

2.08***, Trade 0.01***, GCF 0.01***, Inflation 0.01***, REER 0.06***, and Stock exchange Coefficient 0.01*** highly impact import on US Macroeconomic variable, As Pakistan Export to USA GDP 0.02*** GDP per Capita 0.08***, Trade 0.01***, FDI 3.74***, Remittance 3.88***, GCF 0.09***, Inflation 0.04***, REER 0.06***, and Stock exchange Coefficient 0.01*** high impact export on Pakistan Macroeconomic variable that lead to country economy. The above result indicates each macroeconomic variable of a country affected by import and export. Import and export every country special above country economy base on import and export. Like Pakistan face balance of payment issue and export helping indicator and USA shortage of agricultural product, dairy and natural resources utilized and strengthen the economy.

5. CONCLUSION

The basic purpose of this study to General Diagnostic test for Sustainable Economic Growth Multi Dependent Panels of Cross Section. The sample size are using “USA import from Pakistan impact on USA economy” and “Pakistan export to USA impact on Pakistan economy” with multi macroeconomic dependent variables of i.e. GDP, GDP per Capita, GCF, Inflation, REER, FDI, Remittances, Trade, and Stock exchange each country for the period of 2012 to 2021 and examine through a new General Diagnostic test of Cross-section diagnostic test (CSDT). Descriptive Statistic results of mean and standard deviation shows the potential of variables. GDP, GDP Per Capita, Inflation, Real exchange rate effect, and FDI, Remittances dependent variable are highly potential. Inflation is very high values mean 30980 and Standard deviation 10927 most influence factor in context of Pakistan. US Stock exchange, Gross Capital Formation and Trade are highly potential variable. Stock Exchange mean 19229, standard deviation 5201.5 highly and leading influencing factor for USA. New General Diagnostic test of Cross-section diagnostic test (CSDT) examine 1210 observation, 11210 sample size and two model result “USA import from Pakistan impact on USA economy” and “Pakistan export to USA impact on Pakistan economy” with multi macroeconomic dependent variables of each country are indicating both models is 1 percent level of significant and US import by Pakistan GDP 0.09***, GDP per Capita 0.05**, FDI 9.81***, Remittances 2.08***, Trade 0.01***, GCF 0.01***, Inflation 0.01***, REER 0.06***, and Stock exchange Coefficient 0.01*** highly impact import on US Macroeconomic variable, and Pakistan Export to USA GDP 0.02*** GDP per Capita 0.08***, Trade 0.01***, FDI 3.74***, Remittance 3.88***, GCF 0.09***, Inflation 0.04***, REER 0.06***, and Stock exchange Coefficient 0.01*** high impact export on Pakistan Macroeconomic variable that lead to country economy. The Cross-section diagnostic test () result indicates each macroeconomic dependent variable of a country highly affected by import and export. Like Pakistan face balance of payment issue and export helping indicator and USA shortage of agricultural product, dairy and natural resources utilized and strengthen the economy. Research implications are very clear import and export of a country is highly significant that meet the need of financial and usage of a country. This study has two main recommendations. First, strongly recommends the Policy maker more focus on exports, meet the need of country with the help of country resources. Second Recommendation is new Multi Dependent panels of cross section result indication of validation and sustainability of Cross-Section General Diagnostic test and CSDT is very useful for future research. This study is strongly recommended to research institution, and research scholar the above new General Diagnostic test Multi Dependent Panels of Cross Section (for Sustainable Economic Growth) is suggested to use for future examination of research data.

Declarations:

Ethical Approval: We declare that all ethical guidelines for authors have been followed by all authors.

Consent to Participate: All authors have given their consent to participate in submitting this manuscript to this journal.

Consent to Publish: All authors have given their consent to publish this paper in this journal.

Competing interests: The authors have no relevant financial or non-financial interests to disclose.

Data availability: The datasets generated and analyzed during the current study are available with the corresponding author on request.

REFERENCES

Ali, G. (2013). EGARCH, GJR-GARCH, TGARCH, AVGARCH, NGARCH, IGARCH and APARCH models for pathogens at marine recreational sites. *Journal of Statistical and Econometric Methods, 2*(3), 57-73.

Anselin, L. (1988a). Lagrange multiplier test diagnostics for spatial dependence and spatial heterogeneity. *Geographical analysis, 20*(1), 1-17.

Anselin, L. (1988b). *Spatial econometrics: methods and models* (Vol. 4): Springer Science & Business Media.

Anselin, L. (2001a). Spatial econometrics. *A companion to theoretical econometrics, 310330*.

Anselin, L. (2001b). Spatial effects in econometric practice in environmental and resource economics. *American Journal of Agricultural Economics, 83*(3), 705-710.

Anselin, L. (2009). Spatial regression. *The SAGE handbook of spatial analysis, 1*, 255-276.

Anselin, L. (2019). The Moran scatterplot as an ESDA tool to assess local instability in spatial association. In *Spatial analytical perspectives on GIS* (pp. 111-126): Routledge.

Anselin, L., & Bera, A. K. (1998). Introduction to spatial econometrics. *Handbook of applied economic statistics, 237*(5).

Baltagi, B. H., Feng, Q., & Kao, C. (2012). A Lagrange Multiplier test for cross-sectional dependence in a fixed effects panel data model. *Journal of Econometrics, 170*(1), 164-177.

Baltagi, B. H., & Li, Q. (1990). A Lagrange multiplier test for the error components model with incomplete panels. *Econometric Reviews, 9*(1), 103-107.

Baltagi, B. H., Song, S. H., & Koh, W. (2003). Testing panel data regression models with spatial error correlation. *Journal of Econometrics, 117*(1), 123-150.

Bhattacharjee, A., & Holly, S. (2011). Structural interactions in spatial panels. *Empirical Economics, 40*(1), 69-94.

Breusch, T., & Pagan, A. (1980). The lagrange multiplier test and its applications for the error components model with incomplete panels. *Review of Economic Studies*, *47*(1), 239-253.

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The review of economic studies, 47*(1), 239-253.

Burridge, P. (1980). On the Cliff-Ord test for spatial correlation. *Journal of the Royal Statistical Society: Series B (Methodological), 42*(1), 107-108.

Burridge, P. (1981). Testing for a common factor in a spatial autoregression model. *Environment and Planning A, 13*(7), 795-800.

Buse, A. (1982). The likelihood ratio, Wald, and Lagrange multiplier tests: An expository note. *The American Statistician, 36*(3a), 153-157.

Carrer, F., Kossowski, T. M., Wilk, J., Pietrzak, M. B., & Bivand, R. S. (2021). The application of Local Indicators for Categorical Data (LICD) to explore spatial dependence in archaeological spaces. *Journal of Archaeological Science, 126*, 105306.

Cliff, A. D., & Ord, J. K. (1975). Model building and the analysis of spatial pattern in human geography. *Journal of the Royal Statistical Society: Series B (Methodological), 37*(3), 297-328.

Cliff, A. D., & Ord, J. K. (1981). Spatial processes: models & applications.

De Jong, P., Sprenger, C., & Van Veen, F. (1984). On extreme values of Moran's I and Geary's c. *Geographical analysis, 16*(1), 17-24.

Engle, R. F. (1982). A general approach to Lagrange multiplier model diagnostics. *Journal of Econometrics, 20*(1), 83-104.

Getis, A. (1995). Cliff, ad and ord, jk 1973: Spatial autocorrelation. london: Pion. *Progress in Human Geography, 19*(2), 245-249.

Getis, A. (2008). A history of the concept of spatial autocorrelation: A geographer's perspective. *Geographical analysis, 40*(3), 297-309.

Getis, A. (2010). Spatial autocorrelation. In *Handbook of applied spatial analysis* (pp. 255-278): Springer.

Haining, R. P. (2003). *Spatial data analysis: theory and practice*: Cambridge university press.

Hammersley, J. (2013). *Monte carlo methods*: Springer Science & Business Media.

Hashem, P. M. (2021). General diagnostic tests for cross-sectional dependence in panels. *Empirical Economics, 60*(1), 13-50.

Jackson, C. (2011). Multi-state models for panel data: the msm package for R. *Journal of statistical software, 38*, 1-28.

James, F. (1980). Monte Carlo theory and practice. *Reports on progress in Physics, 43*(9), 1145.

Mao, G. (2018). Testing for sphericity in a two-way error components panel data model. *Econometric Reviews, 37*(5), 491-506.

Marton, T. (2015). *Spatial concentration of milk production in Norway: The flow of quotas*. Retrieved from

Metropolis, N., & Ulam, S. (1949). The monte carlo method. *Journal of the American statistical association, 44*(247), 335-341.

Mooney, C. Z. (1997). *Monte carlo simulation*: Sage.

Moran, P. A. (1948a). The interpretation of statistical maps. *Journal of the Royal Statistical Society. Series B (Methodological), 10*(2), 243-251.

Moran, P. A. (1948b). Some theorems on time series: II the significance of the serial correlation coefficient. *Biometrika, 35*(3/4), 255-260.

Nugroho, D., Kurniawati, D., Panjaitan, L., Kholil, Z., Susanto, B., & Sasongko, L. (2019). *Empirical performance of GARCH, GARCH-M, GJR-GARCH and log-GARCH models for returns volatility*. Paper presented at the Journal of Physics: Conference Series.

Pesaran, M. H. (1981). Pitfalls of testing non-nested hypotheses by the Lagrange multiplier method. *Journal of Econometrics, 17*(3), 323-331.

Pesaran, M. H. (2006). Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica, 74*(4), 967-1012.

Pesaran, M. H. (2015). Testing weak cross-sectional dependence in large panels. *Econometric Reviews, 34*(6-10), 1089-1117.

Pesaran, M. H. (2021). General diagnostic tests for cross-sectional dependence in panels. *Empirical Economics, 60*(1), 13-50.

Pesaran, M. H., Schuermann, T., & Weiner, S. M. (2004). Modeling regional interdependencies using a global error-correcting macroeconometric model. *Journal of Business & Economic Statistics, 22*(2), 129-162.

Pesaran, M. H., Ullah, A., & Yamagata, T. (2008). A bias-adjusted LM test of error cross-section independence. *The econometrics journal*, *11*(1), 105-127.

Pesaran, M. H., & Zaffaroni, P. (2004). Model averaging and value-at-risk based evaluation of large multi asset volatility models for risk management. *Available at SSRN 642681*.

Ramasamy, R., & Munisamy, S. (2012). Predictive accuracy of GARCH, GJR and EGARCH models select exchange rates application. *Global journal of management and business research*, *12*(15).

Schwarz, K. R., & Mount, J. (2005). Integrating spatial statistics into archaeological data modeling. In *GIS and archaeological site location modeling* (pp. 175-196): CRC Press.

Wang, Y.-H. (2009). Nonlinear neural network forecasting model for stock index option price: Hybrid GJR–GARCH approach. *Expert Systems with Applications*, *36*(1), 564-570.

Zellner, A. (1962). An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. *Journal of the American statistical association*, *57*(298), 348-368.

Zellner, A., & Huang, D. S. (1962). Further properties of efficient estimators for seemingly unrelated regression equations. *International Economic Review*, *3*(3), 300-313.