İstanbul İktisat Dergisi - Istanbul Journal of Economics 72, 2022/2, s. 653-687
ISSN: 2602-4152
E-ISSN: 2602-3954

RESEARCH ARTICLE / ARAŞTIRMA MAKALESİ

Intra-BRICS Trade: A Panel Data Analysis with Structural Breaks

BRICS Ülkelerinde Ticaret: Yapısal Kırılmalı Panel Veri Analizi

Alper YILMAZ[1]

ABSTRACT

This article attempts to examine the recent developments that have amplified the consequences of uncertainty regarding trade between Brazil, Russia, India, China, and South Africa (BRICS) countries under global economic turmoil such as occurred in the 2008 financial crisis and trade wars sparked by the USA and the COVID-19 pandemic. These events severely affected intra-BRICS trade and investment. For this purpose, we employed the Westerlund and Edgerton cointegration approach to check for cointegration under structural breaks and the procedure for the asymmetric Granger non-causality test to assess the causal relationship between the custom tariff and export variables of BRICS countries with regard to the panel data methodology for the 2000-2020 period using annual data. The empirical results for cointegration indicate the presence of a long-term relationship; in other words, they are seen to move together under investigation. The estimated breakpoints correspond with 2008 and the ongoing financial turmoil and with the 2018-2020 period and the rising trade disputes between USA and China. In addition, the Granger non-causality test provides enough evidence to show opposite directions (signs) for the causal links between the variables that run from tariffs to exports for BRICS countries.

Keywords: International trade, Tariff, Panel data analysis
JEL Classification: F10, F13, C23

ÖZ

Bu çalışmada, 2008 küresel finansal krizi, ABD-Çin ticaret savaşları, Covid-19 pandemisi gibi belirsizlikleri artırıcı gelişmelerin, BRICS ülkeleride birlik içi ticarete etkileri irdelenmeye çalışılmıştır. Söz konusu gelişmeler, BRICS ülkeleri ticareti ve yatırımları üzerinde ciddi etkiler doğurmuştur. Bu amaçla 2000-2020 dönemi gümrük tarifeleri ve ihracat değişkenlerine ait yıllık veriler bağlamında, değişkenler arasındaki eş bütünleşme ilişkisi Westerlund ve Edgerton yaklaşımı ile yapısal kırılma altında ve yine seriler arasındaki Granger nedensellik ilişkisi ise asimetrik nedensellik testi ile panel veri modelleri kullanılarak analiz edilmiştir. Eş bütünleşme sonuçlarına göre ilk olarak seriler arasında uzun dönemli bir ilişki olduğu yani serilerin birlikte hareket ettiği tespit

DOI: 10.26650/ISTJECON2022-1096747

[1]Assistant Professor, Adnan Menderes University, Soke Faculty of Business Administration, Aydın, Turkiye

ORCID: A.Y. 0000-0002-1253-7097

Corresponding author:
Alper YILMAZ,
Faculty Member, Adnan Menderes University, Söke Faculty of Business Administration, Aydın, Turkiye
E-mail: alper.yilmaz@adu.edu.tr

Submitted: 01.04.2022
Accepted: 06.06.2022
Online Publication: 15.08.2022

Citation: Yilmaz, A. (2022). Intra-BRICS trade: A panel data analysis with structural breaks. *İstanbul İktisat Dergisi - Istanbul Journal of Economics*, *72*(2), 653-687. https://doi.org/10.26650/ISTJECON2022-1096747

edilmiştir. Eş bütünleşme ilişkisindeki yapısal kırılma tarihleri 2008 finansal krize, krizin etkili olduğu yıllara ve ABD-Çin ticari geriliminin yaşandığı 2018-2020 dönemine tekabül etmektedir. Diğer yandan Granger nedensellik testi değişkenler arasında gümrük tarifelerinden ihracata doğru zıt yönlü (işaretli) nedensellik ilişkisinin varlığı hakkında yeterli delil sunmaktadır.

Anahtar kelimeler: Uluslararası ticaret, Tarifeler, Panel veri analizi
JEL Sınıflaması: F10, F13, C23

1. Introduction

Over the last decades, disruptive events such as the 2008 financial crash, the USA-China trade dispute, and the COVID-19 pandemic have had significant impacts (e.g., company shut-downs, pressure on economic growth and investments, rising inflation and unemployment, deglobalization, increased uncertainty, market volatility, and global depression) on the global economy and international trade. International markets, in particular commodities, tourism, airlines, and logistic sectors have been negatively affected, with trade demand fluctuating dramatically. However, the most challenging adverse outcomes have been the rise in protectionism and non-tariff barriers. The limited protectionism perspective has grown gradually in the aftermath of the 2008 financial collapse. Later on, it accelerated from the USA-China trade war and reached its plateau during the COVID-19 pandemic. For instance, 1,400 new measures that discriminate against foreign products were put in place during the 2008 crisis and its recessionary aftermath, despite leading economies underscoring the critical importance of rejecting protectionism. During the 2018-2020 period, the USA increased import tariffs from 2.6% to 16.6% on 12,043 products covering $303 billion (12.7%) in annual imports to protect itself against China (Fajgelbaum, Goldberg, Kennedy, and Khandelwal, 2019).

Historical experiences show that countries tend to implement protective trade policies during times of crises and recessions and return to free trade when economic indicators start working out. Thus, protectionism is an exception, and free trade is the rule. According to the theory of free trade, economies are better off increasing employment, supplying a wide variety of goods for domestic consumers, exploiting economies of scale, narrowing down imperfect competitive markets by increasing competition, and accessing larger external markets, which act as a stimulus for exports and may result in a win-win scenario (Agosin, 1999).

2. Theoretical Framework

The most famous theories in this context are classical trade theories. The first one is the Adam Smith's absolute advantage theory, which states a country that produces a good more efficient than a partner country can be accepted as having an absolute advantage and should export this good, and the second one is David Ricardo's comparative advantage theory, which states a country that produces a good at lower opportunity cost than a partner country can exports this good due to the relative advantage. In addition, Heckscher and Ohlin (as cited in Zestos, Jiang, and Painter, 2021) developed the factor proportions theory, which explains why countries develop comparative advantages with regard to certain commodities. All these theories are based on the technological superiority of one country over a partner country. When assuming countries *X* and *Y* and goods *A* and *B*, absolute advantage theory can be expressed through labor productivity as follows due to labor being assumed as the only factor of production:

$$\alpha_{LA}^{X} < \alpha_{LA}^{Y} \text{ or } \frac{1}{\alpha_{LA}^{X}} > \frac{1}{\alpha_{LA}^{Y}} \quad ; \quad \alpha_{LB}^{Y} < \alpha_{LB}^{X} \text{ or } \frac{1}{\alpha_{LB}^{Y}} > \frac{1}{\alpha_{LB}^{X}} \tag{1}$$

where α_L represents the labor in hours needed to produce one unit of product and its reciprocal $1/\alpha_L$ represents the labor productivity of production. This model would say country *X* has an absolute advantage with product *A* relative to country *Y*, and country *Y* has an absolute advantage for product *B* relative to country *X*. However comparative advantage explains international trade through opportunity cost as follows:

$$\frac{\alpha_{LA}^{X}}{\alpha_{LB}^{X}} < \frac{\alpha_{LA}^{Y}}{\alpha_{LB}^{Y}} \; ; \; \frac{\alpha_{LB}^{Y}}{\alpha_{LA}^{Y}} < \frac{\alpha_{LB}^{X}}{\alpha_{LA}^{X}} \tag{2}$$

According to the model, country X has a comparative advantage in producing product A, and country Y has a comparative advantage in producing product B. Hence, both theories consider countries' specializations with respect to their comparative advantage as the basis of world welfare, with countries being able to reach a higher level of consumption than the autarky level. When trade barriers are eliminated, trade gains can be achieved. As such, governments should not limit international trade flows. Accordingly, the spread of liberalism and the expansion of world trade accelerated during 19th and 20th century (Schumacher, 2012).

However, classical trade theory has been criticized in terms of unrealistic and arbitrary assumptions (e.g., perfect competition, constant returns to scale, assuming labor as the only productive factor) and for insufficiently meeting expectations about trade gains. Developing countries have learned over time that trade relations are not equal and no fair trade exists due to the economic complexity, resource abundance, power, and path dependency of different countries. These factors create an unbalanced trade relationship that favors developed countries at the expense of developing ones. In other words, international trade has created both "winners" and "losers" (Lau, 2020).

For this reason, in the late 19th century and after the Great Depression in 1929, protectionism became increasingly prevalent in the world, and protective trade policies began widely being accepted. Protectionists developed their arguments against free trade over time on subjects such as national defense, infant industry, balance of payments, and employment. In this framework, protectionism can be defined as an economic policy limiting international trade through the use of restrictive regulations and policy tools that discourage imports, get trade surpluses, and protect domestic industries. To achieve protectionist goals, many kinds of tools have been used such as tariffs and non-tariff barriers (Fouda, 2012).

The impact of protective trade policy is analyzed through tariffs and import quotas. According to tariff theory, the first phase (i.e., free trade phase) sees goods *A* being imported without tariffs from abroad at prices cheaper than domestic ones. This firstly leads to an increase in consumer surplus and welfare. However, imposing a tariff (whether specific or *ad valorem*) or quotas makes imported goods more expensive, cuts back domestic consumption due to imported goods being more expensive, and increases domestic production due to the relatively cheaper cost of domestic goods compared to imported ones. A deadweight welfare loss from the distortion of domestic production and consumption decisions (Amiti, Redding, and Weinstein, 2019). Therefore, imposing tariffs harms consumers while benefitting domestic producers. Tariffs also raise revenues for the government. As a result, consumers will choose to buy domestic goods instead of imported goods. There is no state in the world that has eliminated all of its trade barriers. More or less, every country sets tariff rates according to its national economic goals (Mankiv, 2018).

Another theory is the optimal tariff argument. According to optimal tariff theory, imposing tariffs results in two contrasting effects: improvement in terms of trade (positive effect) and reduction in the volume of trade (negative effect). Welfare improvement takes place only when the gains from the terms of trade exceed the losses in trade volume. At this point, an optimum tariff is reached, and economic welfare has been maximized. This point can be expressed as the indifference curve of the tariff-imposing country, which has monopsony market power to influence world prices, becoming tangent to the offer curve of a partner country where the exchange between partners takes place (Bowen, 2015). To determine the optimum tariff, we can start with the social welfare (*W*) function where $W = 1 - \sum_g \left[\pi_g(p_g) + r_g(p_g) + \psi_g(p_g) \right]$. This function is maximized as follows by the tariff τ_g:

$$\tau_g p_g^* \frac{dm_g}{d\tau_g} - m_g \frac{dp_g^*}{d\tau_g} = 0 \quad \forall g \in G_m \tag{3}$$

where *g* is the traded good, p_g^* is the export price, p_g is the domestic price, m_g is the import demand, and p_g is the tariff revenue. The left term in the equation represents distortion in trade volume, and the right term expresses the terms of the trade effect. If this country has no monopoly power, export supply elasticity would be infinite, and the $dp_g^* / d\tau_g$ ratio would be zero. Otherwise, the optimal tariff is positive. As stated in the literature, low tariffs are insufficient for higher exports. This is because reduced tariffs may not result in lower export prices, and trade patterns may not be very sensitive to changes in tariff rates. Therefore, one should consider export supply elasticity. In that case, the point of optimal tariff can be shown as follows (Broda, Limao, and Weinstein, 2006):

$$\tau_g^{opt} = \left[(dm_g^* / dp_g^*)(p_g^* / m_g^* \right]^{-1} \tag{4}$$

As a result, imposing tariffs on one hand leads to improvement in terms of trade and increases the level of welfare, while on the other hand, it results in significant negative spillover effects for the remaining world through retaliatory tariffs.

Therefore, General Agreement on Tariffs and Trade (GATT) and World Trade Organization (WTO) members declared strong commitments to lower tariff rates and non-tariff barriers. In particular, the Uruguay Round that was signed in 1994 alone provides an average 40% tariff cut for developed economies. After the 1980s, trade policies of the new multilateral system started promoting reducing trade barriers, competition, transparency, and predictability and refused to allow discrimination between imported and locally-produced goods. In the case of high-income nations, following the GATT/WTO rules and bound tariff levels was particularly important for stabilizing the global economic system. However, the 2008 financial collapse, the trade war between USA and China, and the COVID-19 over the last decade have resulted in volatility in world trade volumes, lowering by 9% in 2009, 2.6% in 2018, and 5.3% in 2020. A trade war can be defined as a situation in which a partner country attempts to damage the other's exports by imposing higher tariffs and non-tariff barriers to protect the domestic economy and achieve a trade surplus at the expense of its partner. However, this kind of policy results in a large drop in trade volumes, which leaves everybody worse off (Kapustina et al., 2020).

In the light of the great uncertainties surrounding the current global political and economic situation, the role of emerging countries has been focused on growing academic interests. Due to economic and political uncertainties, the trend toward liberalizing trade has slowed down. However, BRICS countries have gained more weight in international trade and prevented retaliatory trade tariffs during the last decades. BRICS countries have huge economic potential and a significant place in the global economy, accounting for 42% of the global population and 23% of the global GDP. Also, they accounted for over 17% of the world's total exports and almost 16% of the world's total imports as of 2020. Over the last decade, BRICS' GDP grew about 179%, and their trade volume rose by 94%. From 2008 to 2020, the world's average growth rate was around 2.39%, while BRICS' rate was about 4.28%. They have moved up the value chains progressively. The collective size of BRICS countries is expected to become as large as the USA's (Chen and Scott, 2021). With these numbers, BRICS have served as a stabilizer in international trade against volatility. Closer economic cooperation for shared prosperity is a priority for BRICS.

They recognize that a sustainable trade environment is only possible on the basis of a fair global economic system. Therefore, BRICS countries have always made efforts for political and diplomatic actions to achieve the peaceful resolution of disputes in the area of international trade (Thorstensen, Tiago, and Oliviera, 2014). Although trade war tensions have escalated over the last decade, BRICS countries as a legal entity launched an official cooperation mechanism and underscored the importance of an open world economy. The rise of BRICS countries has boosted the multilateral trade system against the imposition of unilateral trade war-related tariffs. For instance, their applied weighted average tariff rates for all products were 13.3% in 2000 and decreased to 5% in 2020. Not only BRICS countries but also other formations have larger stakes in the multilateral rule-based trade system, and their role is becoming more important (Hooijmaaijers, 2021).

3. Literature Review and Contribution

The relationship between tariff rates and exports has long been studied in the literature both theoretically and empirically with regard to many aspects of the consequences of protective or liberal trade policies have on international trade. Some of the papers have handled the issue from an elasticity perspective and analyzed the effect of tariff change on exports through price elasticity by interpreting the estimated coefficients. Other papers have conducted cointegration or causality tests through logarithmic transformations and interpreted the direction of causality (bivariate or univariate) by estimating the cointegration coefficients. Still other papers have focused on the effect liberalization programs have on exports' performance. Within the framework of new trade theories, some studies have also emphasized on how increases in trade barriers can reduce domestic consumption of an imported product and consumer surplus and studied the effect on domestic production based on a decrease in exports. Other studies are also found to have focused on protective aspects, examining the role input tariffs have on imports and exports to assess the effective rate of protection.

From the Industrial Revolution to the Great Depression, world economies experienced consistent growth patterns. Growth of international trade volume was impressive in line with the prevailing classical trade theories and liberal economic policies. After the Great Depression, however, the winds changed, and protectionism was raised to revive economies. Following the early 1930s, average tariff rates soared, and many countries imposed higher trade barriers. These trade barriers contributed to a sharp contraction in world trade, which fell by more than 50%. In this framework, the economic literature started to examine the positive and negative effects of tariffs. The findings from these papers showed that increased tariff levels have an effect that decreases export levels in line with price elasticity (i.e., export price). Also, protectionism is very costly to the domestic economy. In this respect, Santos and Thirwall (2004), Eichengreen and Irwin (2010), Fajgelbaum et al. (2019), Amiti et al. (2019), and Gutiérrez and Machuca (2021) all indicated tariff reductions to result in lower export prices and tariff rates to have significant power on exports performance. On the other hand, Bagwell and Staiger (2001), Aggarwal (2004), and Zestos et al. (2021) examined the impact of tariff reductions have on international trade and found just a minor effect to occur on export and import volumes. Following the 1950s, a large number of newly independent underdeveloped countries joined GATT in the early 1960s, and pressure to reduce or remove tariffs from the developing world intensified. As such, industrialized countries moved from tariffs to non-tariff barriers during the 1960s and 1970s to avoid GATT's regulations on committing to non-discriminatory practices and lowering tariff rates. As a result, the effect non-tariff barriers had on international trade has become one of the more famous topics in the literature. In this context, Day, Khan, and Oshikawa (2001), Uprasen (2014), Izotov and Tochkov (2020), and Zhang, Hajiyev, and Smirnov (2021) focused on the effect of non-tariff barriers such as voluntary export restraints, license requirements, value-added trade protection, quotas, and quarantine and concluded non-tariff barriers to leads to trade conflicts, to disrupt trade flows, and to be very harmful for bilateral trade. After the neo-liberal periods of the 1980s, new economic policies mandated the reduce of government intervention and the reintroduction of open competition into economic life by introducing fewer tariffs, less regulation, open borders, and free trade flows and removing non-tariff barriers. To this extent, the economic literature has grown in regard to the effects liberalism has on international trade. On that note, some studies are found such as Joshi and Little (1996), Bleaney (1999), Santos (2002), and Sofjan (2017) suggested that the countries which had embarked on liberalization programs to improved their export performance. On the other hand, Clarke and Kirkpatrick (1992), Jenkins (1996), and Agosin (1999) found little evidence to uphold the relationship between trade liberalization and export growth. After the 2008 global financial turmoil, governments resorted to trade protectionism in order to support their economies, just as had been done in the Great Depression. Increases in trade-restrictive measures would affect 1-3% of trade during 2010-2011. Due to protectionist policies, long-lasting negative effects have resulted in new tensions between USA and China. Trade wars have intensified between these long-standing rivals. USA abandoned the concept of free trade in order to preserve its status as global leader. But as history proves, trade wars have no winners, and many countries suffer losses in economic growth, employment, inflation, trade volume, capital flows, and risk perception. At the same time, some countries may be benefit from the diversion regarding the import demands of struggling parties. On that note, the economic and financial implications of trade wars have become hot topic in the literature since 2017. Evenett and Martin (2010), Evenett (2009), Vinogradov, Salitsky, and Semenova (2019), Kapustina et al. (2020), and Zhang et al. (2021) showed trade wars to have both negative and positive effects. Since the Biden administration in the USA, its growing trade tension with China has lessened. Just before this time in December 2019, the COVID-19 pandemic was first identified from an outbreak in Wuhan, China. During the pandemic, global trade suffered a significant contraction in 2020-2021, and this has had significant negative impacts on the global economy. Therefore, this topic has attracted attention from researchers. In this framework, Berthou and Stumpner (2020), Czech, Wielechowski, Kotyza, Benešová, and Laputková (2020), Hayakawa and Mukunoki (2021), MacGregor and Hála (2021), Javier, Lucio, and Crespo (2021), and Kiyota (2022) found evidence that COVID-19's impact had resulted in decreased trade volumes for many countries, but not at the same strength.

As seen from these papers, tariff barriers, non-tariff barriers, and trade tensions can be accepted as important determinants of exports. Accordingly, the main goal of this study is to determine whether and how tariffs have a relationship with exports among BRICS countries under the uncertainty of the last decade in the framework of the panel data methodology. Our paper has some notable contribution margins. First, we shed light on the debate about protectionism by studying the effects tariffs have on exports under high volatility due to adverse developments (i.e., 2008 financial turmoil, trade war between USA and China, and the COVID-19 pandemic). We explore co-movement between tariffs and exports by employing a cointegration model with multiple structural breaks in both the level and slope of the relationships being taken into account. Using common factors in the model allows a better understanding of the potential effects from these uncertainties. Also, the model constrains neither the constant nor the trend to zero. Secondly, this study can improve the strength of conventional univariate testing approaches by using panel data. Thirdly the study extends analyses over causality links in the frame of asymmetric relationship, because negative and positive shocks affect economic measures independently. Economies are increasingly interlinked across borders due to accelerated trade relations and formations. As such, having economic agents react differently to positive and negative shocks is reasonable to assume.

4. The Model Specifications and Study Method

Upon examining the empirical literature on the relationship between exports and tariff, the bivariate panel model is seen to be specified as follows:

$$\text{exports}_{it} = \alpha+\beta_i \text{tariff}_{\text{it}} + \mu_i + \varepsilon_{\text{it}} \tag{5}$$

In the model, the exports variable (exports of BRICS members to one another in billions of U.S. dollars) is a proxy for international trade. In the model, the exports variable is dependent and the tariff is the independent variable that is applied to the weighted mean of all HS-2 level products as a percentage. β_i is the parameter vector of the slope coefficients, μ_i is country specific effects, α is the constant term, ε is a stochastic error term (independent and identically distributed [IID] error term), *i* and *t* refer to the cross-sectional unit (i = 1,…,5) and time period (2000-2020), respectively. The data were compiled from the World Bank online database and IMF database (direction of trade statistics). The panel consists of the five BRICS countries of Brazil, Russia, India, China, and South Africa.

4.1. Cross Section Independence

Cross-sectional independence is an important diagnostic test before performing the main analysis. It is related to a possible dependence in error terms between cross-sections (e.g., individual countries) due to common shocks, unobserved components, or spatial dependence. It plays an important role in detecting cointegration and causality links. Ignoring cross section dependence may affect the first-order properties (unbiasedness and consistency) of standard panel estimators and misrepresent the biased estimates and spurious inference (Hatemi, Ajmi, Montasser, Lotz, and Gupta, 2015). Firstly, we estimate the following panel data regression model:

$$\Delta y_{i,t} = d_i + \delta_i y_{i,t} + \sum_{j=1}^{p_i} \lambda_{i,j} \Delta y_{i,t} + u_{i,t} \tag{6}$$

where p is the lag length and d_i is the deterministic (constant or trend) component. In this test, the null hypothesis H_0 assumes Covariance (u_{it}; u_{it}) = 0 for all t and $i \neq j$; this is in the face of the alternative cross-sectional dependence, where the hypothesis H_1 assumes Cov (u_{it}; u_{jt}) ≠ 0 for at least one pair of $i \neq j$. In this framework, the Lagrange multiplier (LM) developed by Breusch and Pagan (1980) is performed as follows:

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 \tag{7}$$

where N is the number of countries, T is the time period, $\hat{\rho}_{ij}$ is the sample estimate of the pair-wise correlation of the residuals from the ordinary least squares (OLS) estimation from Equation 6 for each i. However, the LM test is only valid for a relatively small N and sufficiently large T. The attempt is made to resolve this problem using Pesaran's (2004) version of the LM test as follows:

$$CD_{LM} = \left[\frac{1}{N(N-1)} \right]^{1/2} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T \hat{\rho}_{ij}^2 - 1) \tag{8}$$

The CD_{LM} test statistic has a standard normal distribution under the hypothesis H_0 with $T \rightarrow \infty$ first and then $N \rightarrow \infty$. However, it exhibits substantial size distortions when N is large and T is small, even if CD_{LM} is applicable under N for large T values. Therefore, the shortcomings of the LM and CD_{LM} test clearly point out the need for a cross-sectional dependence test applicable under large values of N and small values of T. Therefore, Pesaran (2004) proposed the following test statistic:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\rho_{ij}\right) \quad (9)$$

The last test for determining cross section independence is the bias adjusted Lagrange multiplier (LM_{ADJ}) test developed by Pesaran, Ullah, and Yamagata (2008).

$$LM_{ADJ} = \sqrt{\frac{2}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\rho_{ij}\right) T\hat{\rho}_{ij}\frac{(T-k)\hat{\rho}_{ij}^{2}-\mu_{Tij}}{\sqrt{\upsilon_{Tij}^{2}}} \quad (10)$$

where N is the number of cross section, unobserved heterogeneity μ_{Tij} is the mean of $(T-k)\hat{\rho}_{ij}^{2}$ (IID error term), υ_{Tij} is the variance of $(T-k)\hat{\rho}_{ij}^{2}$, $\hat{\rho}_{ij}$ is the sample estimation for pairwise correlation of residuals from the OLS estimation of the main model, and k is the number of regressors. The estimated test statistics from this equation are normally distributed. The null hypothesis of cross-sectional independence is expressed as $H_0 = \sigma_{ij} = 0$ for $i \neq j$.

4.2. Testing for slope heterogeneity

This section should determine whether homogeneity or heterogeneity is valid for the slope coefficients. Panel data models allow for heterogeneity between individual groups to allow individual-specific effects. Researchers should avoid the false imposition of parameter homogeneity, because assuming homogeneity in the causal relationships between variables may be misleading (Wang, Phillips, and Su, 2016). For this purpose, we employed the $\widetilde{\Delta}$ (delta) and $\widetilde{\Delta}_{adj}$ (adjusted delta) tests developed by Pesaran et al. (2008) based on an assumption of serially uncorrelated errors in dynamic models. In order to check slope homogeneity, the test statistics are estimated as follows:

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - k}{\sqrt{2k}}\right) \quad \tilde{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - E(\tilde{z}_{iT})}{\sqrt{\operatorname{var}(\tilde{z}_{iT})}}\right) \tag{11}$$

where the expected value of error term z is $E(\tilde{z}_{iT}) = k$, with k number of explanatory variables and variance expressed as $Var(\tilde{z}_{iT}) = 2k(T-k-1)/T+1$. The number of cross sections is N, and $\tilde{S}$ is the Swamy test statistic.

4.3. Fourier panel KPSS test

After determining cross section independence and slope homogeneity, the study can now proceed to introduce the unit root test. In this respect, second-generation tests have found more room in the literature due to their ability to regard cross-section dependency. Otherwise, disregarding cross-section dependency would lead to biased and inconsistent estimations and is why they are no longer reliable (Bai & Ng, 2004). However, if structural breaks contained in the data-generating process (DGP) are omitted, traditional second-generation tests would lose strength, as previously shown by Perron (1989). Therefore, the literature has developed to include structural breaks by employing the dummy variables (Zivot & Andrews, 1992; Lee & Strazicich, 2003) and smooth transition (Kapetanios, Shin, and Snell, 2003) approaches. These two methods assume non-gradual structural shifts initially and require knowing break dates. Also, shifts with multiple breaks may cause problems to arise such as estimating the location of breaks, determining the maximum break number, and power loss. To cope with these shortcomings, Enders and Lee (2012a, 2012b) and Becker, Enders, and Lee (2006) suggest Fourier approximations based on Gallant's (1981) suggestion that a series has several smooth (gradual) shifts. Using Fourier frequency components allows unit root tests without breaks having to have an exact form or known *a priori* dates or numbers. After the development of panel data analysis, unit root tests became more common, with Enders and Lee (2012b) and Lee, Wu, and Yang (2015) having developed the panel version of the Fourier unit root test. The test also allows for cross-section independence and heterogeneity in a panel with a common factor structure. The test starts with the following model:

$$y_{it} = \alpha_i(t) + r_{it} + \lambda_i F_t + \varepsilon_{it} \tag{12}$$

$$r_{it} = r_{it-1} + u_{it} \tag{13}$$

where i (1, 2, …, N) and t (1, 2, …, T) are the cross-section dimensions and time periods, $\alpha_i(t)$ is the deterministic term, r_{it} is a random walk process for all i, and ε_{it} and u_{it} are mutually IID error terms. The independently distributed terms F_t and λ_i are the unobserved common factor and loading weights, respectively. The common factor F_t is serially uncorrelated and stationary by $E(F_t) = 0$, $E(F_t^2)$ $E(F_t^2) = \sigma_F^2 > 0$ and are assumed to be known beforehand. For most econometric models, the slope of time trend and intercept are allowed to fluctuate over time. Therefore, deterministic terms (e.g., intercept, time trend) can be defined in the Fourier expansion using the nonlinear trend function as follows:

$$\alpha_i(t) = a_i + b_i t + \gamma_{1i} \sin\left(\frac{2\pi kt}{T}\right) + \gamma_{2i} \cos\left(\frac{2\pi kt}{T}\right) \tag{14}$$

where γ_{1i} and γ_{2i} measure the displacement and magnitude of shifts, $b_i t$ is the time trend, and k is the Fourier frequency. In Equation 14, the slope and intercept of the time trend are allowed to fluctuate over time. Therefore, the Fourier function catches any changes in deterministic term by employing γ_{1i} and γ_{2i}, which enables a smooth curve to be drawn. Also, cross-section independence is considered by using the cross-section averages. The unit root's null hypothesis H0 of $\rho i = 1$ is tested for all i against the alternative hypothesis of H1, which states $\rho i < 1$ for some i. The individual statistic is achieved by extending Becker et al.'s (2006) KPSS test as follows:

$$\eta_i(k) = \frac{1}{T^2} \frac{\sum_{t=1}^{T} \tilde{S}_{it}(k)^2}{\tilde{\sigma}_{\varepsilon i}^2} \tag{15}$$

where $\tilde{S}_{it} = \sum_{j=1}^{t} \tilde{\varepsilon}_{ij}$ is the partial sum of the OLS residuals obtained from Equation 12 and $\tilde{\sigma}_{\varepsilon i}^2$ is the long-term variance of ε_{it}. In the test, we estimate the Fourier KPSS statistics for all cross sections and their individual averages as:

$$FP_k = \frac{1}{N} \sum_{i=1}^{N} KPSS_i \tag{16}$$

Next, we apply the normalization procedure using the mean $\xi(k)$ and the variance $\zeta^2(k)$ to achieve standard normal distribution as follows:

$$FZ(k) = \frac{\sqrt{N}[FP(k) - \xi(k)}{\zeta^2(k)} \quad N(0,1) \tag{17}$$

4.4. Panel LM test with structural break

In order to determine long-term relationships, the cointegration analysis needs to be referenced. For that purpose, the second-generation panel cointegration test with structural break developed by Westerlund and Edgerton (2008) was conducted. The empirical literature has many tests, but most of them are unable to consider structural changes in series that cover long periods of time. Ignoring structural breaks may render the estimation inefficient and biased. As a consequence, the cointegration test based on an LM statistic has been proposed, as it is appropriate in the presence of an unknown number of structural breaks at the data level. In addition, the test is also able to handle cross-section independence and slope homogeneity. Firstly, the following pooled log-likelihood function is considered:

$$Log(L) = \text{constant} - \frac{1}{2}\sum_{i=1}^{N}\left(T\log(\sigma_i^2 - \frac{1}{\sigma_i^2}\sum_{t=1}^{T} e_{it}^2 \right) \tag{18}$$

This function is profiled with respect to the variance of e_{it}, where $\hat{\sigma}_i^2 = \frac{1}{T}\sum_{t=1}^{T} e_{it}^2$; then the score contribution for unit *i* is calculated as:

$$\frac{\partial \log(L)}{\partial \phi_i} = \frac{1}{\hat{\sigma}_i^2}\sum_{t=2}^{T}(\Delta\hat{S}_{it} - \Delta\hat{S}_i)(\hat{S}_{it-1} - \hat{S}_i) \tag{19}$$

where $\hat{S}_{it}$ is the certain residual, and $\Delta\hat{S}_i$ and $\hat{S}_i$ are the respective mean values for $\Delta\hat{S}_{it}$ and $\hat{S}_{it-1}$. To calculate the cointegration coefficient ϕ_i, we regress $\hat{S}_{it-1}$ on $\Delta\hat{S}_{it}$:

$$\Delta\hat{S}_{it} = \text{constant} + \phi_i\hat{S}_{it-1} + \text{error} \tag{20}$$

Equation 20 contains a cointegration relationship if $\phi_i < 0$ and no cointegration if $\phi_i = 0$. In the case of no cross-section independence, $\hat{S}_{it}$ is estimated as follows:

$$\hat{S}_{it} = y_{it} - \hat{\alpha}_i - \hat{\delta}_i D_{it} - \hat{\eta}_i t - x'_{it}\hat{\beta}_i - (D_{i1}x_{it})'\hat{\gamma}_i \tag{21}$$

Due to Δz_{it} being unknown, the principal component is applied to $\Delta\hat{z}_{it}$. However, to account for cross-section dependence, the unobserved common factors ($\Delta\hat{z}_{it} = \lambda'_i \Delta F_t + \Delta v_{it}$) are added to the main model. Regression-based tests for cointegration assume cross-section dependency to include structural breaks in the deterministic components of the process. However, in empirical economic applications, this is rarely seen because countries/regions depend on each other in the globalized world. Therefore, cross-section independency is allowed by using common factors (see Bai & Ng, 2004). Next, the remaining parameter estimates can readily be obtained by running the least squares on the first-differenced version of the panel model:

$$\Delta y_{it} = \hat{\eta}_i + \hat{\delta}_i \Delta D_{it} + (\Delta x_{it})'\hat{\beta}_i + \Delta(D_{it}x_{it})'\gamma + \Delta\hat{z}_{it} \tag{22}$$

where $\hat{S}_{it}$ can be estimated by subtracting the estimated common component from the right-hand side of Equation 21:

$$\hat{S}_{it} = y_{it} - \hat{\alpha}_i - \hat{\delta}_i D_{it} - \hat{\eta}_i t - x'_{it}\hat{\beta}_i - (D_{i1}x_{it})'\hat{\gamma}_i - \hat{\lambda}'_i \hat{F} \tag{23}$$

Here, the LM test would be robust against cross-section dependence due to the common factors (*F*). Secondly because of serial correlation, the mean value of the residual is added to the test regression:

$$\Delta\hat{S}_{it} = \text{constant} + \phi_i \hat{S}_{it-1} + \sum_{j=1}^{p_i} \phi_{ij}\Delta\hat{S}_{it-j} + \text{error} \tag{24}$$

where the panel test statistic (Ø) and *t* ratio (tau) statistic are computed as follows:

$$\text{LM}_{\phi}(i) = T\hat{\phi}_i \left(\frac{\hat{\omega}_i}{\hat{\sigma}_i}\right); LM_{\tau}(i) = \frac{\hat{\phi}_i}{SE(\hat{\phi}_i)} \tag{25}$$

where long-run variance (*lrvar*) is $\hat{\omega}_i$ = *lrvar* $(\Delta v_{it}) = \sigma_i^2 / \phi_i$, and $\hat{\phi}_i$ are the least squares estimate of ϕ_i in Equation 24. Lastly, the following test statistic can be defined to estimate the breakpoints. This test not only allows for a level break but also for a regime shift. As mentioned earlier, the breakpoint is individually estimated for each unit of cross-section by minimizing the sum of the squared residuals from the first-difference regression in Equation 22. Thereby, we can estimate the unknown breakpoints in both the intercept and slope as follows:

$$\hat{\tau}_i = \underset{0|<\tau_i<1}{\arg\min} \frac{1}{T-1} \sum_{t=2}^{T} (\Delta \hat{z}_{it})^2 \tag{26}$$

As seen from Equation 26, the breakpoints are estimated at the minimize of the test values from across all possible break dates.

4.5. Estimating cointegration coefficients

The ordinary least squares (OLS) estimator is known to be unusable under a cointegration relationship because parameters are super-consistent under cointegration, which leads to an endogeneity problem. Under this problem, exogenous shocks or disturbance terms are correlated with endogenous variables. This is said to occur in a multiple regression model when $E(u | x) \neq 0$. In this case, the OLS estimates of the βs will no longer be unbiased or consistent in case of cointegration (Breitung & Pesaran, 2005). As such, the following four methods exist for estimating the cointegration coefficients: correlated common effect (CCE; Peseran, 2006), augmented mean group (AMG; Eberhardt & Teal, 2010), continuously updated fully modified ordinary least squares (Cup-Fmols; Bai & Kao, 2006), and bias-adjusted estimator of ordinary least squares (Ba-OLS; Westerlund, 2006) to estimate cointegration coefficients.

4.6. Asymmetric causality test

The last stage we utilize the Granger causality analysis to check the causality relationships between variables. We aim to check whether *X* does or doesn't contain useful information for predicting *Y* over and above the past histories. *X* can be said to cause *Y* if *X* has the power to predict current and future values of *Y* by using all available information. The literature has different tests, and some have been developed for panel models. However, these tests are based on the assumption that the causal impacts of positive shocks have the same absolute magnitude as negative shocks. This means asymmetry is not allowed in these tests. In practice, however, economic agents react differently to negative shocks compared to positive ones. For this reason, Granger and Yoon (2002) introduced the concept of hidden cointegration, which is based on cumulative positive and negative shocks. Finally, Hatemi-J (2011) extended the causality test for panel models to allow for asymmetric causal effects with the understanding that positive and negative shocks may have different causal impacts. Also, this test can be applied under possible cross-section dependency across members of the panel. Apart from previous tests, the causal effect is asymmetric with regard to whether the potential causal variable is rising or falling Let x_1 represent export volume and x_2 represent tariffs. They are expressed as the following panel model by assuming each variable to have been integrated to the first degree with the corresponding solution obtained using the recursive method and are presented as follows:

$$x_{i1,t} = x_{i1,t-1} + e_{i1,t} = x_{i1,0} + \sum_{j=1}^{t} e_{i1,j} \tag{27}$$

$$x_{i2,t} = x_{i2,t-1} + e_{i2,t} = x_{i2,0} + \sum_{j=1}^{t} e_{i2,j} \tag{28}$$

where t = 1, 2,…, T is the time dimension, i = 1, 2, …, n is the size of the cross-sectional dimension, constants x_1 and x_2 are the initial values of the variables, and e_1 and e_2 are the white noise error terms. The following equations can be formulated to identify the positive and negative shocks:

$$e^{+}_{i1,t} := \max(e_{i1,t}, 0), e^{+}_{i2,t} := \max(e_{i2,t}, 0), \quad e^{-}_{i1,t} := \min(e_{i1,t}, 0), e^{-}_{i2,t} := \min(e_{i2,t}, 0)$$

where a positive value of the error term gives positive shocks and a negative value of the error term gives negative shocks. Based on these definitions, positive and negative shocks can accordingly be identified in each variable as the following cumulative sums:

$$x^{+}_{i1,t} = x^{+}_{i1,0} + e^{+}_{i1,t} = x_{i1,0} + \sum_{j=1}^{t} e^{+}_{i1,j} \tag{29}$$

$$x^{+}_{i2,t} = x^{+}_{i2,0} + e^{+}_{i2,t} = x_{i2,0} + \sum_{j=1}^{t} e^{+}_{i2,j} \tag{30}$$

$$x_{i1,t}^{-} = x_{i1,0}^{-} + e_{i1,t}^{-} = x_{i1,0} + \sum_{j=1}^{t} e_{i1,j}^{-} \tag{31}$$

$$x_{i2,t}^{-} = x_{i2,0}^{-} + e_{i2,t}^{-} = x_{i2,0} + \sum_{j=1}^{t} e_{i2,j}^{-} \tag{32}$$

After transforming the data, in order to reveal the causality relationship between positive and negative cumulative shocks at this stage, we have to estimate the vector autoregression (VAR) and seemingly unrelated regression (SUR) model of order *k*, VAR-SUR(k), as follows:

$$\begin{bmatrix} x_{i1,t}^{+} \\ x_{i2,t}^{+} \end{bmatrix} = \begin{bmatrix} \beta_{i0} \\ \gamma_{i0} \end{bmatrix} + \begin{bmatrix} \sum_{r=1}^{k} \beta_{i1,r} & \sum_{r=1}^{k} \beta_{i2,r} \\ \sum_{r=1}^{k} \gamma_{i1,r} & \sum_{r=1}^{k} \gamma_{i2,r} \end{bmatrix} \times \begin{bmatrix} x_{i1,t-r}^{+} \\ x_{i2,t-r}^{+} \end{bmatrix} + \begin{bmatrix} \varepsilon_{i1}^{+} \\ \varepsilon_{i2}^{+} \end{bmatrix} \tag{33}$$

where *k* is the lag order selected in such a way as to minimize the information criterion. After determining the optimal lag order, the null hypothesis is that the k^{th} element of $x_{i2,t}^{+}$ does not Granger cause $x_{i1,t}^{+}$ for the cross-sectional unit *i* in the panel and is defined as $H_0 : \beta_{i2,r} = 0, \forall r.$, where *r* = 1, 2, …., *k*. The null test can be examined using the following Wald test:

$$wald = (R\hat{\beta})'[R\hat{V}ar(\hat{\beta})R']^{-1}(R\hat{\beta}) \tag{34}$$

where *R* is an indicator matrix consisting of the one and zero elements. Causality can also be tested between negative components $(x_{i1,t}^{-}; x_{i2,t}^{-})$, positive to negative $(x_{i1,t}^{+}; x_{i2,t}^{-})$, and negative to positive $(x_{i1,t}^{-}; x_{i2,t}^{+})$ in the same way.

5. Empirical Findings

We begin our analysis with summary statistics before running the main model of the research question. For this purpose, we looked into the mean, variance, skewness, and kurtosis levels of the dataset, and the results are shown in Table 1. To check the normality of the data set, we estimate the skewness, kurtosis, and Jarque-Bera statistics. In accordance with the test statistics, the null hypothesis of the error terms being normally distributed has not been rejected.

Table 1: Summary Statistics of Data Set

Layout	Exports	Tariff	Covariance Analysis		
Mean	37,562,394	7.44		**Exports**	**Tariff**
Median	19,428,504	6.32	Exports	1.86842E+15	-67378273.01
Maximum	176,000,000	26.51	Tariff	-67378273.01	19.40714005
Minimum	1,084,239	2.38	**Correlation Analysis**		
Std. Dev.	43,432,503	4.43		**Exports**	**Tariff**
Skewness	0.83	0.38	Exports	1	-0.57
Kurtosis	2.05	2.28	Tariff	-0.57	1
Jarque-Bera	2.296	3.271	Sum	3.94E+09	780.95
Probability	0.31	0.24	Sum Sq. Dev.	1.96E+17	2,037.75

Secondly, the correlation analysis, which can be thought of as some kind of a linear relationship between variables with correlation values ranging from -1 to +1, shows that both variables are moderately correlated (probability value exceeds the 0.5% significance level), and the negative sign means the changes in the two variables are in opposite directions. Lastly, covariance, expressed as *cov* (*x*; *y*), is a quantitative measure of how much two random variables vary together. In other words, it signifies the direction of the linear relationship between the two variables and measures how two variables change together (Orloff & Bloom, 2014). As seen on the right side of Table 1, the negative covariance coefficient between exports and tariffs indicates that the variables tend to show opposite behavior. However, concluding the direction of causality and cointegration relationship between them is impossible. As such, we have to run proper tests to have a clear view of their relationship. Nonetheless, before proceeding to the implementation of the main model, a preliminary analysis is required.

We first begin by employing the cross-sectional dependence (CD) test. Neglecting cross-section dependence is well known to be able to lead to biased estimates and spurious inferences. The assumption of homogeneous slopes is unlikely to hold due to countries' different economic structures. Also, imposing the joint restriction for the whole panel homogeneity may cause country-specific characteristics to be overlooked (Luintel & Khan, 2009). Thus to make decisions, we used the CDLM (Pesaran, 2004a), $CDLM_1$ (Breusch & Pagan, 1980), $CDLM_2$ (Pesaran 2004b), and bias-adjusted CD (Pesaran et al., 2008) tests.

Table 2: Results for Cross Sectional Dependence and Slope Homogeneity Test

Cross Section Dependency Tests	**Exports**		**Tariffs**	
	Stat.	**p**	**Stat.**	**p**
$CDLM_1$	25.68***	0.00	21.11**	0.02
$CDLM_2$	3.57***	0.00	2.486***	0.00
CDLM	-3.087**	0.02	-2.987***	0.00
Bias-adj.CD	-0.481	0.68	4.948***	0.00
Slope Homogeneity Test				
Δ Test	-1.094	0.86	-1.161	0.81
Δ_{Adj}Test	-1.263	0.89	-1.341	0.91

Note: ***, **, and * indicate the null hypothesis to be rejected at respective 1%, 5%, or 10% significance level.

According to Table 2, the null hypothesis is strongly rejected regarding cross-section independency. As a result, we need to use second-generation unit root, cointegration, and causality tests to build an appropriate model with regard to cross-section dependency. Table 2 also illustrates the rejection of slope homogeneity for all variables. Therefore, imposing homogeneity restrictions on the variable of interest results in misleading inferences. These findings indicate that a shock that had occurred in one of the BRICS members seems to have been transmitted to other members.

After determining slope homogeneity and cross-section dependency, we can check unit root. According to Table 3, the probability values of the panel statistics show the null hypothesis of the unit root (variables have jointly stationarity) has been rejected at the 1% significance level.

Table 3: Panel Unit Root Test Results

Exports							
Level Shift Model				**Constant &Trend Shift Model**			
ID	*FKPSS*	*beta_Ft*	*t_Ft*	ID	*FKPSS*	*beta_Ft*	*t_Ft*
1	0.044	1.77	3.56***	1	0.05	1.73	3.32***
2	0.03	1.32	1.99*	2	0.01	1.21	1.77*
3	0.02	-0.98	1.71*	3	0.02	-0.94	-1.09
4	0.01	1.44	2.45**	4	0.01	1.47	2.37**
5	0.04	1.42	2.64***	5	0.03	1.52	2.75***
Panel Statistics;				**Panel Statistics;**			
LM_{Mean}	0.0344	*P-KPSS*	2.654	LM_{Mean}	0.0357	*P-KPSS*	0.014

Mean	0.0658	Probability	0.00	*Mean*	0.0146	Probability	0.02
Variance	0.0028			Variance	0.0221		
Tariff							
Level Shift Model				**Constant &Trend Shift Model**			
ID	*FKPSS*	*beta_Ft*	*t_Ft*	ID	*FKPSS*	*beta_Ft*	*t_Ft*
1	0.39	0.288	2.26**	1	0.09	0.68	4.21***
2	0.46	0.91	5.58***	2	0.1	0.12	0.54
3	0.12	2.71	18.81***	3	0.08	2.93	10.5***
4	0.18	0.93	6.57***	4	0.17	1.02	3.64***
5	0.17	0.14	3.58***	5	0.12	0.22	2.96***
Panel Statistics:				**Panel Statistics:**			
LM_{Mean}	0.2646	*P-KPSS*	2.083	LM_{Mean}	0.1164	*P-KPSS*	3.699
Mean	0.1411	Probability	0.02	*Mean*	0.0523	Probability	0.00
Variance	0.0176			Variance	0.0024		

Note: ***, **, and * indicates the null hypothesis to be rejected at the respective 1% (1.645), 5% (1.960), or 10% (2.578) significance level.

Table 3 also shows individual statistics. The Fourier panel test allowed some of the cross-sections (e.g., some countries) to be stationary. For this purpose, BRICS members are respectively represented according to ID number. *FKPSS* represents the Fourier KPSS statistics. F_t is the unobserved common factors expressed by *beta_*F_t that lead to cross-section dependency across *i*. According to *beta_*F_t statistic, all countries are affected positively by common factors except the third country with respect to the variable *exports* and positively affected as a whole from common factors for the variable *tariffs*. Lastly, the *t* statistics (*t_*F_t) for all coefficients are statistically significant except for the third country, which means India follows the *I*(0) process, with regard to the variable of *exports* and for the second country, meaning Russia follows the *I*(0) process, with regard to the variable of tariffs in the Constant & Trend Shift Model. However, for the Level Shift Model, all coefficients are statistically significant and follow the *I*(1) process.

After determining the unit root properties of the series, we go further by testing for the cointegration, as described earlier. The rationale behind this test is that international trade has exhibited structural developments with regard to the USA-China trade war and COVID-19 pandemic. As stated earlier with respect to the unit root test, both the export and tariff series can be concluded to appear non-stationary, and thus we can now check for a cointegration relationship between these variables. To this end, we employ the LM-based test developed by Westerlund and Edgerton (2008), as it allows for multiple breaks.

Table 4: Panel Cointegration Test

	$Z_\tau(N)$		$Z_\phi(N)$	
Model	**Test Statistic**	**p**	**Test Statistic**	**p**
No Break	-0.251	0.39	0.767	0.77
Level Shift	-1.933**	0.02	-1.511*	0.06
Regime Shift	-6.361***	0.00	-7.686***	0.00
	Level Shift Model		**Regime Shift Model**	
	Country ID	**Break Location & Date**	**Country ID**	**Break Location & Date**
	1	11 / 2010	1	12 /2011
	2	8 /2007	2	9 /2008
	3	9 /2008	3	10 /2009
	4	17 /2017	4	18 /2018
	5	13 /2012	5	14 /2013

Note: ***, **, and * indicate the null hypothesis to be rejected at the respective 1% (1.645), 5% (1.960), or 10% (2.578) significance level. Max factor is assigned as 3.

The results from the cointegration test are reported in Table 4. The results suggest the null hypothesis of no cointegration to not be rejectable in the No Break Model at all conventional significance levels, while being rejectable for the Level Shift and the Regime Shift Models for both the $Z\tau(N)$ and $Z\phi(N)$ statistics respectively at the 5% and 10% levels of significance. However, the Regime Shift Model exhibits better fit than the Level Shift Model. Also, a cointegration relationship can be concluded to exist between the variables in the Regime Shift Model for both the $Z\tau(N)$ and $Z\phi(N)$ statistics at a 1% level of significance. Without exception, the values are negative and thus lie to the right of the center of the asymptotic normal distribution for both the Level Shift and Regime Shift Models. The bottom of Table 4 presents the break dates for the two models. These points have been identified by the test procedure. According to the results, Brazil, Russia, India, and South Africa experienced their breakpoints during the 2008 global financial crisis and aftershock periods. However, China as the remaining BRICS country experienced her break during the well-known trade war period with the USA that escalated throughout 2017-2021 in particular.

After confirming the long-term cointegration, the coefficients were estimated through Bai and Kao's (2006) continuously updated fully modified ordinary least squares (Cup-FMOLS), Westerlund's (2006) bias-adjusted OLS (Ba-OLS), Pesaran's (2006) common correlated effect (CCE), and Eberhardt and Teal's (2010) augmented mean group (AMG) estimation methods to take into account cross-section dependency and heterogeneity. The cointegrating vectors need to be properly estimated and tested with regard to cointegration. The results are reported in Table 5.

Table 5: Cointegration Coefficients

Estimator	β_i	**Standard Errors**	**t - statistics**
OLS	-1.681	3.934	-0.427
Cup-FMOLS	-1.768	1.044	-1.693
Ba-OLS	-1.899	1.112	-1.708
Estimator	β_i	**Z - statistics**	**probability values**
CCE	-1.139	4.89	0.00
AMG	-1.076	0.148	0.23

(**Estimated equation;** $\text{Exports}_{it} = \alpha + \beta_i \text{Tariff} + v_i + \varepsilon_{it}$)

The cointegration parameters in Table 5 indicate the variable of exports with its negative *βi* values to be negatively associated with the variable of tariffs at a statistically significant level except for the OLS and AMG methods, with the coefficients ranging between |1| and |2|. According to the estimations, a one-unit increase in tariff decreases exports by 1.768 units in the Cup-FMOLS method, 1.899 units in the Ba-OLS method, and 1.139 units in the CCE method. As a result, when evaluating both the panel cointegration and estimators, the empirical findings imply tariffs to be a factor effective at determining the long-run behavior of exports in BRICS countries.

The last section of the study shows Tables 6a and 6b to report the causality results for the panel model. In this context four different types of direction are identifiable for either positive or negative shocks and can be combined as follows:

➢ *from* X^+ *to* Y^+ → *positive to positive shocks (an increase in* X *does not Granger cause an increase in* Y*)*

➢ *from* X^+ *to* Y^- → *positive to negative shocks (an increase in* X *does not Granger cause a decrease in* Y*)*

➢ *from* X$^-$ *to* Y$^-$ → *negative to negative shocks (a decrease in* X *does not Granger cause a decrease in* Y*)*

➢ *from* X$^-$ *to* Y$^+$ → *negative to positive shocks (a decrease in* X *does not Granger cause an increase in* Y*)*

In the panel model, *X* (tariffs) is the explanatory variable, and *Y* (exports) is the dependent variable. Testing for asymmetric causality in the model is mainly based on separating positive and negative shocks. Generally, economic shocks is a term that refers to events occurring unexpectedly outside of a particular economic system but that still have a significant impact on the system. They can be sharp, lead to sudden and fundamental changes in the system, and have serious effects on macroeconomic outcomes and measures of economic performance such as trade volume, unemployment rate, aggregate consumption, and inflation rate (Hill & Wolman, 2012). For another example, Funke, Granziera, and Imam (2008) and Becker and Mauro (2006) described trade shocks as a term describing sudden, large, and enduring changes either in import or export prices that tend to affect income. Accordingly, the worsening terms of trade that lead to a decline in the relative price of exported goods refers to negative shocks and recovering terms of trade that lead to an increase in the relative price of exported goods refers to positive shocks. In our context, export shocks refer to unexpected external factors that have positive (favorable) or negative (unfavorable) effects on exports both in terms of volume and/or value. Secondly, tariff shocks represent the external factors that drive up tariff rates and that tighten or expand trade environment (e.g., imposing or removing quotas, safeguard measures, or other trade barriers). The deepening of trade liberalization after the neo-liberal periods of the 1980s with regard to trade policies may be associated with positive shocks, whereas the undesired increases in tariff rates during the 2008 global financial crisis and trade war of the Trump era may be associated with negative shocks.

In this regard, the asymmetric causality results in Table 6a provide evidence for the causality relationship. Firstly, we were unable to find any causality from positive tariff shocks to positive exports shocks individually except for India, and thus the null hypothesis of no causality can be rejected for all panels at the 1%

significance level. On the other hand, the null hypothesis of negative tariff shocks not leading to similar shocks in negative exports shocks cannot be rejected at either the individual or panel levels for all BRICS countries. When addressing causality from positive tariff shocks to negative exports shocks, the null hypothesis of no causality can be rejected for all countries except South Africa at the individual and panel levels. Similarly, negative tariff shocks not causing positive exports shocks can be rejected for all countries except Brazil for both the individual and panel levels at a 1% level of significance.

Table 6a. The Asymmetric Panel Causality Test Results

Country	tariff $^{+}$ ≠> exports^{+}				tariff $^{+}$ ≠> exports $^{-}$			
	Lag	M-Wald	Prob.	Conclusion	Lag	M-Wald	Prob.	Conclusion
Brazil	2	0.09	0.99	H_0 Accept	2	18.97***	0.00	H_0 Reject
Russia	1	0.01	0.90	H_0 Accept	2	11.24***	0.00	H_0 Reject
India	1	13.87***	0.00	H_0 Reject	1	7.81***	0.00	H_0 Reject
China	2	1.02	0.37	H_0 Accept	2	10.88***	0.00	H_0 Reject
South Africa	2	0.36	0.54	H_0 Accept	2	0.78	0.29	H_0 Accept
Panel Fischer		18.59***		H_0 Reject		29.55***		H_0 Reject
p		0.00				0.00		
Country	**tariff $^{-}$ ≠> exports $^{-}$**				**tariff $^{-}$ ≠> exports^{+}**			
	Lag	**M-Wald**	**Prob.**	**Conclusion**	**Lag**	**M-Wald**	**Prob.**	**Conclusion**
Brazil	1	1.39	0.23	H_0 Accept	2	0.24	0.58	H_0 Accept
Russia	1	0.08	0.93	H_0 Accept	2	4.26***	0.00	H_0 Reject
India	1	0.87	0.34	H_0 Accept	2	3.57***	0.00	H_0 Reject
China	1	0.47	0.48	H_0 Accept	1	8.74***	0.00	H_0 Reject
South Africa	2	0.06	0.79	H_0 Accept	1	11.39***	0.00	H_0 Reject
Panel Fischer		7.01		H_0 Accept		24.57***		H_0 Reject
p		0.72				0.00		

Note: ***, **, and * indicate the null hypothesis to be rejected at the respective 1%, 5%, or 10% significance level. H0: Tariffs do not cause exports.

However, in the case of causality that runs from exports to tariffs, the null hypothesis is unable to be rejected for either positive or negative directions at the individual and panel levels. Therefore, not enough evidence is found to support the presence of Granger causality. As seen in Table 6b, the null hypothesis is rejected only for China (the positive to negative case) and India (the negative to positive case).

Table 6b: The Asymmetric Panel Causality Test Results

Country	export $^{+}$ ≠> tariff^{+}				export $^{+}$ ≠> tariff $^{-}$			
	Lag	M-Wald	Prob.	Conclusion	Lag	M-Wald	Prob.	Conclusion
Brazil	1	0.76	0.38	H_0 Accept	1	0.02	0.88	H_0 Accept
Russia	2	0.08	0.77	H_0 Accept	2	0.21	0.64	H_0 Accept
India	2	1.32	0.25	H_0 Accept	1	1.15	0.28	H_0 Accept
China	1	0.11	0.91	H_0 Accept	1	3.67*	0.05	H_0 Reject
South Africa	1	0.45	0.51	H_0 Accept	2	0.27	0.62	H_0 Accept
Panel Fischer		6.76		H_0 Accept		1.47		H_0 Accept
p		0.74				0.40		
Country	**export $^{-}$ ≠> tariffs $^{-}$**				**export $^{-}$ ≠> tariff^{+}**			
	Lag	**M-Wald**	**Prob.**	**Conclusion**	**Lag**	**M-Wald**	**Prob.**	**Conclusion**
Brazil	2	0.14	0.89	H_0 Accept	1	1.43	0.23	H_0 Accept
Russia	2	1.14	0.67	H_0 Accept	1	2.66	0.10	H_0 Accept
India	2	0.25	0.61	H_0 Accept	1	6.59**	0.01	H_0 Reject
China	1	0.34	0.55	H_0 Accept	1	0.73	0.39	H_0 Accept
South Africa	1	0.04	0.82	H_0 Accept	2	0.04	0.83	H_0 Accept
Panel Fischer		2.52		H_0 Accept		11.85		H_0 Accept
p		0.97				0.12		

Note: ***, ** and * indicates the rejection of null hypothesis at the 1%, 5% and 10% significance level respectively. H0: Tariffs do not cause exports

6. Conclusion and Policy Implication

According to the results, a long-term equilibrium relationship has been found between the series. In other words, any deviations in the short run due to external shocks are corrected together in the long run. This implies that tariffs are an important factor determining the long-term behavior of exports. Correspondingly, according to the cointegration equation, all estimators produce nearly the same results in terms of magnitude and statistical significance except for the AMG estimator. More specifically, an increase in tariffs has a negatively significant impact on exports in all cases. In regard to the correlation coefficients, tariffs are negatively correlated to exports, as illustrated in Table 1. These findings indicate tariff reduction to be able to significantly contribute to export performance. We also investigated the causal relationship between series using the asymmetric panel causality test, and the results suggest that causal relationships run from tariffs to exports.

The literature has many examples that prove trade barriers due to disputes or protective policies to act as supply shocks that result in a decrease in exports. For example, according to the World Bank Computable General Equilibrium Model, the introduction of a 25% tariff on all Chinese goods imported to the USA will reduce world exports by 3%.

The United States and other Western Economies have consistently been a critical part of the multilateral trading system and mostly conducted trade policies according to GATT/WTO rules. The unfolding of the financial crisis in 2008 put into question the leadership of the USA and European Union (EU). After the 2008 financial crisis, the unipolar era of USA global domination and the power of G-7 Economies appears to have faded in the face of the developing world. The tectonic shifts in the global balance of economic power that centered on the preponderance of old power has evolved into a multipolar economic world where the current trade regime has been established. The role that Asian and other economic formations have in globalization processes and their share in international trade are likely to strengthen. Their government representatives have begun gaining a certain weight in decision-making in international organizations and global economic governance and also exert influence on key issues underpinning trade and investment policies.

BRICS countries have emerged as a trade power in a multi-polar world due to outward-oriented trade policies during the slow down of neoliberal policies over the last decades. BRICS are significantly diverse compared to other developing countries with regard to their economic size, trade volume, resource structure, and foreign direct investment. They started by being inward-oriented with a relatively low base economic structure. However, they have adopted export-based development strategies in line with outward-oriented trade policies since the 1960s. As stated by many studies, being outward oriented makes allows a country to use external capital, resulting in more rapid growth of exports, more benefits from foreign technologies, and savings. During this period, most BRICS countries, in particular China and India, experienced a more rapid growth in trade and capital inflows compared to the major developed markets. Although all BRICS are abundant in low-skilled labor and relatively lacking in human and financial capital, they have taken structural measures such as facilitating foreign investment and carrying out liberal reforms in order to overcome these hardships. In line with their outward orientations, trade openness among BRICS ranges from 32% in Brazil to 51% in South Africa.

Meanwhile, BRICS have adjusted their integration policies with other developing countries in order to get more trade volume and capital inflows. BRICS countries have enhanced economic cooperation and trade ties on several levels since the early 2000s. The original idea was to create a politically cohesive group as a counterbalance to the major international players of the USA and the EU. As such, they maintained their initiatives to continue cooperating with the G-8 and other traditional dialogue partners. BRICS' first meetings date back to 2008, and the formalization of the group as a new voice on the international stage took place in 2009. Participation from South Africa in 2011 strengthened the cooperation. Intra-BRICS integration is made up of free trade agreements and export-oriented strategies based on tariff exemptions, tariff reductions, and trade facilitations that cover many goods and service sectors (e.g., the 2020 Regional Comprehensive Economic Partnership Agreement). Close trade and business ties are also helpful at providing BRICS with new market access and greater export diversification and at developing a wide range of industrial activities. Consequently, the magnitude of BRICS in the global trade flow and their contribution to the global trade turnover has approximately tripled over the last two decades. In parallel, intra-BRICS trade has increased impressively from $19 billion in 2000 to $340 billion in 2020. As of 2020, BRICS's contribution to global imports and exports are 16% and 17%, respectively. Exports already remain the main driver of today's BRICS economies. Trade and investments are key elements in the BRICS narrative, as BRICS have resisted all forms of trade protectionism and fought disguised restrictions on trade. High growth, expanding trade, and increasing FDI inflows and outflows have made BRICS significant players in the global economy. For that reason, our results have some implications both for developing countries and other economic formations. These results have been interpreted as follows: Policymakers should carry out trade policies more cooperatively in order to provide an open, stable, equitable, and non-discriminatory environment for international trade.

Ethics Committee Approval: I declare that all processes of the study comply with research and publication ethics, and that I comply with ethical rules and scientific citation principles.
Peer-review: Externally peer-reviewed.
Conflict of Interest: The author has no conflict of interest to declare.
Grant Support: The author declared that this study has received no financial support.

References

Aggrawal, A. (2004). Impact of tariff reduction on exports: A quantitative assessment of Indian exports to USA. *Indian Council For International Economic Relations*, Working Paper No. 120.

Agosin, M. R. (1999). Trade and growth in Chile. *CEPAL Review, 1999*(68), 79-100. doi:10.18356/18ba57ab-en

Amiti, M., Redding, S. J. & Weinstein, D. (2019). The impact of the 2018 trade war on USA prices and welfare. *NBER Working Papers*, 25672. doi:10.3386/w25672

Bagwell, K. & Staiger, R. (2001). Reciprocity, non-discrimination and preferential agreements in the multilateral trading system. *European Journal of Political Economy, 17* (2), 281-325. doi:10.1016/s0176-2680(01)00029-5

Bai, J., & Kao, C. (2006). Chapter 1 on the estimation and inference of a panel Cointegration model with cross-sectional dependence. *Panel Data Econometrics - Theoretical Contributions and Empirical Applications,* 3-30. doi:10.1016/s0573-8555(06)74001-9

Bai, J. & Ng, S. (2004). A panic attack on unit roots and co-integration. *Econometrica, 72*(4), 1127–1178. doi:10.1111/j.1468-0262.2004.00528.x

Becker, R., Enders, W. & Lee, J. (2006). A stationarity test in the presence of an unknown number of smooth breaks. *Journal of Time Series Analysis, 27*(3), 381–409. doi:10.1111/j.1467-9892.2006.00478.x

Becker, T., & Mauro, P. (2006). Output drops and the shocks that matter. *SSRN Electronic Journal*. doi:10.2139/ssrn.926227.

Berthou, A. & Stumpner, S. (2020). Quantifying the impact of the US-China trade war on exports. *https://www.freit.org/WorkingPapers/Papers/TradePolicyMultilateral/FREIT1674.pdf.*

Bleaney, M.F. (1999), Price and monetary dynamics under alternative exchange rate regimes. *IMF Working Papers, 99*(67),1. doi:10.5089/9781451848885.001

Bowen, L. (2015). Rethinking the optimal tariff theory. *Chicago Policy Review* https://chicagopolicyreview.org/2015/01/15/rethinking-the-optimal-tariff-theory/#:~:text=The%20optimal%20 tariff%20theory%20argues,buyer%20from%20many%20competing%20suppliers

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

Breitung, J. & Pesaran H. (2005). Unit roots and co-integration in panels. *Economic Studies Discussion Paper*, Series 1, No 42/2005, ISBN 3–86558–105–106.

Broda, C., Limao, N. & Weinstein, D. (2006). Optimal tariffs: The evidence. *NBER Working Paper Series,* No: 12033, http://www.nber.org/papers/w12033.

Chen, J. & Scott, G. (2021). Brazil, Russia, India, China and South Africa (BRICS), https://www.investopedia.com/terms/b/brics.asp.

Clarke, R. and Kirkpatrick, C. (1992), 'Trade Policy Reform and Economic Performance in Developing Countries: Assessing the Empirical Evidence', in R. Adhikari, C. Kirkpatrick and J. Weiss (eds.), *Industrial and Trade Policy Reform in Developing Countries,* Manchester: Manchester University Press, pp. 56–73.

Czech, K., Wielechowski, M., Kotyza,P., Benešová, I. & Laputková, A. (2020). Shaking stability: COVID-19 impact on the visegrad group countries and financial markets. *Sustainability, 12*(15), 6282. doi:10.3390/su12156282

databank.worldbank.org/data/source/world-development-indicators

Day, M., Khan, M. & Oshikawa, M. (2001). Tariff and non-tariff barriers to trade and economic development in Bangladesh. *Journal of World Trade*, *35*(2), 253-273. doi:10.54648/337900

Eberhardt, M. & Teal F. (2010). Productivity analysis in global manufacturing production. *Economics Series Working Papers 515,* University of Oxford, Department of Economics.

Eichengreen, B., & Irwin, D. A. (2010). The slide to protectionism in the Great Depression: Who succumbed and why? *The Journal of Economic History*, *70*(4), 871-897. doi:10.1017/s0022050710000756

Enders, W. & Lee, J. (2012a). A unit root test using a Fourier series to approximate smooth breaks. *Oxford Bulletin Economics and Statistics, 74*, 574–599.

Enders, W. & Lee, J. (2012b). The flexible Fourier form and Dickey-Fuller type unit root tests. *Econ. Letters. 117*, 196–199.

Evenett, S. J. (2009). What can be learned from crisis-era protectionism? An initial assessment. *Business and Politics, 11*(3), 1-26. doi:10.2202/1469-3569.1287

Evenett, S. & Martin, W. (2010). A snapshot of contemporary protectionism: How important are the murkier forms of trade discrimination. *Econ Stor, ARTNeT Working Paper Series*, No. 83.

Fajgelbaum, P. D., Goldberg, P. K., Kennedy, P. J., & Khandelwal, A. K. (2019). The return to protectionism. *NBER Working Papers,* 25638. doi:10.3386/w25638

Fouda, R. A. N. (2012). Protectionism and free trade: a country's glory or doom? *International Journal of Trade, Economics and Finance*, *3*(5), 351-355. doi:10.7763/ijtef.2012.v3.226

Funke, N, Granziera, E. & Imam, P. (2008). Terms of trade shocks and economic recovery. *IMF Working Paper, African Department,* WP/08/36.

Gallant, A. (1981). On the bias in flexible functional forms and an essentially unbiased form. *Journal of Econometrics, 15*(2), 211-245. doi:10.1016/0304-4076(81)90115-9

Granger, C.W. & Yoon, G. (2002). Hidden co-integration. *Department of Economics Working Paper, University of California, San Diego, 2002 (02),* 1-49.

Gutiérrez Chacón, E., & Machuca, C. M. (2021). The effect of tariffs on Spanish goods exports. *SSRN Electronic Journal*. doi:10.2139/ssrn.3852904

Hatemi-J, A., Ajmi, A. N., El Montasser, G., Inglesi-Lotz, R., & Gupta, R. (2015). Research output and economic growth in G7 countries: New evidence from asymmetric panel causality testing. *Applied Economics, 48*(24), 2301-2308. doi:10.1080/00036846.2015.1117052

Hatemi-J, A. (2011). Asymmetric causality tests with an application. *Empirical Economics, 43*(1), 447-456. doi:10.1007/s00181-011-0484-x

Hayakawa, K. & Mukunoki. H. (2021). Impacts of COVID-19 on global value chains. *The Developing Economies*, *59*, 154–177.

Hill, E. W. & Wolman, H. (2012). Economic shocks and regional economic resilience, affiliation: Building resilient regions. *Institute for Government Studies,* University of California, Berkley, January 2012.

Hooijmaaijers, B. (2021). The BRICS countries' bilateral economic relations, 2009 to 2019: Between rhetoric and reality. *SAGE Open, 11*(4), 215824402110541. doi:10.1177/21582440211054128

IMF Balance of Payments and International Investment Position Statistics, Data Querry https://data.imf.org/?sk=7A51304B-6426-40C0-83DD-CA473CA1FD52&sId=1390030341854

Izotov, D. & Tochkov, K. (2020). Trade relations between the Russian Far East and Northeast Asia: Assessment of institutional factors. *In book: Proceeding of the International Science and Technology Conference Far East Con 2019*, 177-188. doi: 10.1007/978-981-15-2244-4_15.

Javier, B., Lucio, J.J. & Crespo E. R. (2021). Effects of COVID-19 on trade flows: Measuring their impact through government policy responses. *Plos One*, *16*(10): e0258356. https://doi.org/10.1371/journal.pone.0258356

Jenkins, R. (1996). Trade liberalization and export performance in Bolivia. *Development and Change, 27* (4), 693-716.

Joshi, V. & Little, I. M. (1996). *India's economic reforms 1991-2001*. Oxford University Press, Print ISBN-13: 9780198290780, doi:10.1093/0198290780.001.0001.

Kapetanios, G., Shin, Y., & Snell, A. (2003). Testing for a unit root in the nonlinear STAR framework. *Journal of Econometrics, 112*(2), 359-379. doi:10.1016/s0304-4076(02)00202-6

Kapustina, L. Lipkova, L. Silin, Y. & Drevalev, A. (2020). US-China trade war: causes and outcomes. *SHS Web of Conferences, 73*, 01012 (2020), IES-2019.

Kiyota, K. (2022). The COVID-19 pandemic and the world trade network. *Journal of Asian Economics, 78,* 101419. doi: 10.1016/j.asieco.2021.101419

Lau, L. (2020). The impacts of the trade war and the covid-19 epidemic on China-USA economic relations. *The China Review, 20*(4), 1–37.

Lee, J. & Strazicich, M. (2003). Minimum LM unit root tests with two structural breaks. *Rev. Econ. Stat. 85,* 1082–1089.

Lee, C., Wu, J. L. & Yang, L. (2015). A Simple panel unit-root test with smooth breaks in the presence of a multifactor error structure. *Oxf. Bull. Econ. Stat. 78*(3), 365–393. doi:10.1111/obes.12109

Luintel, K. B., & Khan, M. (2009). Heterogeneous ideas production and endogenous growth: an empirical investigation. *Canadian Journal of Economics*, *42*(3), 1176–1205. doi:10.1111/j.1540-5982.2009.01543.x

Mankiv, G. (2018). *Principles of economics.* 8 th. Edition, Cengage Learning, SBN 13: 978-1-305-58512-6, Print Number: 01, Print Year: 2016.

MacGregor P. & Hála, M. (2021). CSR Unconscious Consumption by Generation Z in the COVID-19 era, responsible hereticsnot paying CSR Bonus? *Journal of Risk and Financial Management, 14*(18), 390. doi:10.3390/jrfm14080390

Orloff, J. & Bloom J. (2014). Covariance and correlation, introduction to probability and statistics. *MIT Open Course Ware,* https://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability-and-statistics-spring-2014/readings/MIT18_05S14_Reading7b.pdf

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica*, 57, 1361–1401.

Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. *CWPE 0435*, https://doi.org/10.17863/CAM.5113.

Pesaran, M.H. (2006). Estimation and inference in large heterogenous panels with multifactor error structure. *Econometrica, 74*(4), 967-1012. doi:10.1111/j.1468-0262.2006.00692.x

Pesaran, M.H., Ullah A. & Yamagata, T. (2008). A bias-adjusted lm test of error cross-section independence. *Econometrics Journal, 11*(1), 105-127.

Santos, P.U. (2002). Trade liberalisation and the balance of payments in selected developing countries. *UK: The International Economic Study Group (IESG) Easter Conference*, University of Birmingham.

Santos-Paulino, A., Thirlwall, A.P. (2004). The impact of trade liberalisation on exports, imports and the balance of payments of developing countries. *The Economic Journal, Royal Economic Society, 114*(493), 50-72, F50-F72. doi:10.1111/j.0013-0133.2004.00187.x

Schumacher, R. (2012). *Free trade and absolute and comparative advantage.* ISSN (print) 1866-0738 Universität Potsdam, Welt Trends Thesis 16.

Sofjan, M. (2017). The effect of liberalization on export-import in Indonesia. *International Journal of Economics and Financial Issues, 2017, 7*(2), 672-676.

Thorstensen, V., Tiago, I. & Oliviera, M. (2014). BRICS in the World Trade Organization: comparative trade policies. *Ipea, CCGI (FGV) and SAIIA*, March 2014.

Uprasen, U. (2014). The impact of non-tariff barriers in the European Union on China's exports. *Economic Integration in Asia,* 141-164. doi:10.1057/9781137432933_8

Vinogradov, A.O., Salitsky, A.I. & Semenova, N.K. (2019). US-China Economic confrontation: Ideology, chronology, meaning. *Vestnik RUDN. International Relations*, *19*(1), 35-46. doi:10.22363/2313-0660-2019-19-1-35-46

Wang, W., Phillips, P. C. B. & Su, L. (2016). Homogeneity pursuit in panel data models: theory and applications. *Cowles Foundation for Research in Economics Yale University*, November 2016. http://cowles.yale.edu/

Westerlund, J. (2006). On the estimation of co-integrated panel regressions with common factors. *Journal of Financial Econometrics, 5*(3).

Westerlund, J. & Edgerton, D. L. (2008). A simple test for co-integration in dependent panels with structural breaks. *Oxford Bulletin of Economics Statistics*, *70*(5), 665-704. doi:10.1111/j.1468-0084.2008.00513.x

Zestos, K., Jiang, Y. & Painter, C. (2021). Determinants of German and Japanese exports. *Journal of Economic Integration, September 2021*, *36*(3), 339-371. doi:10.11130/jei.2021.36.3.339

Zhang, Y., Hajiyev, N. & Smirnov, V. (2021). Tariff and non-tariff instruments of OPEC+ trade wars. *Energy Strategy Reviews 38*(2021), 100771. doi:10.1016/j.esr.2021.100771

Zivot, E. & Andrews, D.W.K. (1992). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business and Economic Statistics, 10*(3), 251–270. doi:10.2307/1391541