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ARE EXPORTS AND IMPORTS ASYMMETRICALLY COINTEGRATED? EVIDENCE FROM THE EMERGING AND GROWTH-LEADING ECONOMIES[1]

Knowing the possible presence of a long-term connection between exports and imports is important both for current and future macroeconomic policies and for the sustainability of the current account deficit. The existence of a long-term relationship between variables of interest implies that the countries are not in violation of their budget constraints. Moreover, it means that their macro policies are effective. In this context, this paper aims to investigate whether the long-term equilibrium relationship between exports and imports in the emerging and growth-leading economies (EAGLEs) is symmetric or asymmetric. The EAGLE is an acronym introduced by the Spanish bank BBVA in 2010. The members of the EAGLEs are Brazil, China, Egypt, India, Indonesia, Mexico, South Korea, Russia, Taiwan, and Turkey. The annual dataset covers the period from 1960 to 2017. For further comparison, on the one hand, I employed autoregressive distributed lag bound test (ARDL) for analysing symmetric long-term relation among the variables. On the other hand, asymmetric long run convergence is examined via nonlinear ARDL method. According to the results of the linear ARDL test, there exists a strong cointegration association between exports and imports for 3 out of 10 countries. However, the evidence from nonlinear ARDL test shows that the null hypothesis stating the lack of cointegration can be rejected for 8 out of 10 countries. The existence of the cointegration link amongst the series indicates that the trade imbalances are short-term phenomenon and are sustainable in the long-term. In other words, these countries are not in violation of their intertemporal budget constraint.

Keywords: Exports, Imports, Current Account, External Balance, Trade Imbalance, Sustainability, Long-run, ARDL Cointegration, NARDL Cointegration, EAGLEs Countries

1. Introduction

The current account balance is usually taken as a measure of the change in the level of any country's indebtedness. Therefore, the main goal of the macroeconomic policy is to ensure the sustainability of the current account imbalances. If the current account deficit is stable, external debt is believed to be sustainable. On the other hand, if the deficit in the balance of a country's payments is not sustainable, it means that the country is violating its intertemporal budget constraint over time. Exports and imports are two major components of the current account balance that play key roles in the economic growth of a nation. Hence, to assess the sustainability of the current account imbalances, one generally predicts the long run relationship amongst the variables.

According to [1], existence of cointegration among the variables shows that the country is not in violation of its intertemporal budget constraint. In addition, external imbalances are the short run fact and are sustainable in the long run. The macroeconomic policies, such as fiscal and monetary policies are effective tools for bringing exports and imports into equilibrium in the long run. However, the lack of cointegration between the given variables indicates the policy problems for the economy and the presence of a productivity gap [1, p. 204].

Due to its key role, a long run tendency in the trade balance has been receiving increasing inter-

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est in recent years; it has been analysed for numerous countries. The study aims to test if the long-term convergence is linear or nonlinear for the economies of emerging and growth-leading economies (the EAGLEs), which were introduced by a Spanish bank called BBVA in 2010. The EAGLEs are expected to lead global economic growth until 2020 and to provide substantial opportunities for investors. However, the impact of a cointegration relationship between exports and imports on the current account balance as well as on the macroeconomic balance is a well-known issue. Thus, the long-term equilibrium interaction between exports and imports of the EAGLE countries is examined for the period from 1960 to 2017. The dataset differs from country to country. Accessibility to the country specific data was decisive in the selection of the time interval.

The rest of the paper is organised as follows: theoretical background and literature review are presented respectively in Sections 2 and 3. In Section 4, the dataset and econometric methodology are described. In Section 5, empirical results are discussed. Finally, the conclusion is given in the last section.

2. Theoretical Background

[2] has developed a simple framework to test the long-term convergence between exports and imports. The model assumes that the economy has 3 key features. They include: (i), a representative consumer who lives in a small open economy that produces and exports a single composite good; (ii), absence of government control; (iii), the consumer has access to international markets and is able to borrow and lend [2, p. 160]. The current period budget constraint of this economy is given below:

$$C_0 = Y_0 + B_0 - I_0 - \left(1 + r_0\right) B_{-1}, \quad (1)$$

C_0, Y_0 and I_0 are the current consumption, the output, and the investments, respectively. r_0 is the one term global interest rate, B_0 is the international borrowing that might be positive or negative. Finally, $(1 + r_0)\ B_{-1}$ is the initial debt size [2, p. 160]. [2] also introduced a testable standard regression model via:

$$EX_t = \beta_0 + \delta IM_t + \varepsilon_t, \quad (2)$$

[3] has tested the equation (3) by taking the equation (2) as reference:

$$IM_t = \beta_0 + \delta EX_t + \varepsilon_t, \quad (3)$$

In the equations (2) and (3), *EX* is exports of goods and services, *IM* is imports of goods and services, and ε_t is the error term. According to the equations (2) and (3), δ should be equal to 1 and ε should be stationary. This means that the economy is satisfying its intertemporal budget constraint. In other words, the current account imbalances are sustainable when there is a cointegration among exports and imports [2, p. 161]. If δ is less than 1, then exports and imports are acting simultaneously in the long-term but the sustainability of imbalances is weaker [4, p. 159].

The majority of researchers use exports as the dependent variable while others use imports to examine the cointegration relationship between the variables. According to [4], regardless of which variable is taken as the response, the explanations concerning the sustainability of the external balances stay unchanged [4, p. 159].

3. Literature Review

The first author that investigated the long-term link between exports and imports in his study is [2]. [2] has analysed the cointegration for the U.S. economy. In the study, which covers the period of 1967Q1–1989Q4, he applied the Engle-Granger [5] cointegration method and found no evidence of long run relationship. According to [2], the results showed that the U.S. was violating its intertemporal budget constraints. In other words, current account deficits were not sustainable in the U.S.

In the papers that follow [2], the results are variable. In some of these studies, a cointegration connection between exports and imports has been detected, while in others, weak long-term relationship of the lack of it have been observed. A number of these studies are given below. In addition to this, it is argued that countries with more exports will have sufficient foreign exchange reserves to import. Also, the high level of imports due to the inputs used for the production of export goods as well as the production of domestic goods will also increase exports. Hence, a cointegration relationship is expected between these variables regardless which of them is the explained variable [6, p. 10]. Therefore, in this field of interest, there exist many papers that take [3] into account along with [2].

[7] has investigated whether Australia's exports and imports converge in the long run or not. He has utilized the Engle-Granger [5] approach for the period of 1966Q1–1990Q4. According to the evidence, exports and imports are cointegrated. Moreover, the trade deficit of Australia is a short run phenomenon and it is sustainable in the long run. [8] has studied the long run tendency in the current account balance of Turkey by using annual data (1950–1996). He has estimated the two-

step Engle-Granger [5] procedure and has not found any cointegration between exports and imports. In other words, the trade deficit of Turkey is not sustainable or is violating its intertemporal budget constraint in the long run.

[3] has researched the cointegration between exports and imports in 50 countries. All data are derived quarterly and cover the period from 1973Q2 to1998Q1. [3] has employed the Johansen [9], the Stock and Watson [10] and the Phillips and Hansen [11] methods. The results imply that there exists long-term equilibrium relation among the variables of interest in the low-income economies, middle-income economies and high-income economies. Also, the current deficits in most of the countries are sustainable according to [3]. [1] have surveyed the convergence between exports and imports in the long run for the industrialised economies, namely for Germany, Sweden, the USA and the UK. As a result of the applied the Johansen and Juselius [12] test, they have found long run relationship between the variables for all of the considered countries excluding the UK. Therefore, these countries are not violating their international budget constraints. [4] have investigated the cointegration between exports and imports for Fiji and Papua New Guinea (PNG) through the test introduced by [13]. The annual data of the two countries are different. The data covers the period of 1960–2000 for Fiji and 1960–1998 for PNG. According to the ARDL results, exports and imports have long-term relation in both Fiji and PNG. Considering the coefficients, PNG satisfies the weak form of its intertemporal budget constraint while Fiji satisfies the strong form of its intertemporal budget constraint.

[14] have employed the Engle-Granger [5] and the Gregory and Hansen [15] cointegration methods to investigate the external imbalances of Chile. They have considered the post-liberalisation era and used the data for the period from 1975 to 2004. [14] determined that exports and imports are cointegrated and the trade deficit is sustainable in Chile. [16] have examined the long run tendency in the Indian trade balance. They utilised the Johansen and Saikkonen-Lütkepohl cointegration (SLCOIN) techniques for the data set spanning the period 1949–2005. The evidence of cointegration analyses, both with and without a structural break, show that there is no cointegration association between the variables in India. [17] have investigated the sustainability of Malaysia's current account deficit. They have used disaggregated variables, namely industrial round wood, wood pulp, wood fuel, paper and paper board, sawn wood, recovered paper and wood base panel. The yearly data cover the period between 1961 and 2007. The evidence from the Johansen [9] technique indicates that there exists a cointegration between exports and imports in Malaysia.

[18] have analysed the presence of long run equilibrium relationship between Pakistan's export and imports using the Johansen [19] and the Johansen and Juselius [12] methodologies. They have detected that the related variables were cointegrated in the period of 1972–2006. In addition, their results reveal that the exports Granger cause imports and vice versa. [20] have estimated the long-term connection between exports and imports for 16 transition European economies (former communist countries). They took advantage of quarterly data and the data covering the period from the early 1990s to the end of 2006s. According to the Johansen [9] cointegration tests results, there is one cointegration vector for 10 out of 16 former communist countries. [20] have also determined that the current account deficits are sustainable for 5 out of 16 countries. [21] have studied the cointegration relationship between exports and imports for the 23 largest trade partners of the United States. They used monthly data over the period 1985–2005 and implemented cointegration and error correction methods proposed by Engle-Granger [5]. The results obtained from the analyses have confirmed the long-term relationship among the variables of interest for the majority of these 23 countries. According to [21], any self-correcting system on the external balance either doesn't exist or is slow-paced.

[22] has investigated the long-term convergence on the foreign trade of Indonesia and Malaysia. The yearly data span the periods 1960–2008 and 1960–2007 for Indonesia and Malaysia, respectively. For testing the cointegration, the author has employed both the two-step Engle-Granger [5] and the Johansen [9] methodologies. While he has determined the long-term connection between exports and imports in Malaysia, he has not found any cointegration between Indonesia's exports and imports. [23] have surveyed the possible presence of long run equilibrium relationship between exports and imports for the economies of India and Iran. They have used the Engle-Granger [5] method for analysing the period from 1970 to 2010. The evidence from the cointegration test indicates that exports and imports are cointegrated both in India and Iran. In addition to that, in these economies, the disequilibrium between short and long term is being adjusted every year based on the error correction model. [24] has researched the cointegration between exports and imports in Pakistan. He has

used the Engle-Granger [5] and the Johansen [9] analyses to determine the long run relationship. As a result, he has revealed the long-term relation among the associated series for the period of 1972–2012. Another analysis of Pakistan's economy belongs to [25]. [25] have also examined the long run relationship between exports and imports in Pakistan by using yearly data from 1948 to 2013. They have employed the ARDL method for cointegration and the Toda-Yamamoto [26] technique for causality. According to the ARDL and the Toda-Yamamoto test results, there exists cointegration and bidirectional causality between related variables.

By using yearly data that covers the period between 1960 and 2013, [27] has examined whether the trade deficit is sustainable in the Nigeria economy. [27] has decomposed exports and imports like oil and non-oil trade. He has applied three cointegration techniques namely the Johansen [9] cointegration test as well as the ARDL and the Hansen's [28] approach. The evidence of all cointegration tests indicates that there is a long-term relationship between exports and imports in Nigeria. Besides, Nigeria's current account deficit is sustainable. Finally, the Toda-Yamamoto [26] analysis has revealed the presence of two-way causal link between exports and imports. [29] has investigated the long-term convergence within the frame of ARDL, the Philip–Hansen, and DOLS approaches for a number of Middle East and North Africa countries. He has demonstrated that there exists long-term convergence on the external trade for some of the countries in the sample. He also found positive and statistically significant coefficients of elasticity. However, the trade deficits are sustainable for only 2 countries in the sample.

[30] has viewed long run dynamics in South Africa's current account balance. In the study he has applied the Johansen and Juselius [12] method, taking the period of 1985–2012. As a result, he has found a cointegration relationship between exports and imports. Besides, the current account deficit of South Africa is sustainable in the long run. [31] have employed ARDL, Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) methods to determine the long-term convergence between the external trade elements of 13 Economic Community of West African States (ECOWAS) member countries. Their data covers the period from 1970 to 2015. They have confirmed the existence of the convergence in 8 out of 13 countries. They have also established that 5 economies of the sample are not violating their intertemporal budget constraint. [32] have proved the existence of cointegration between exports and imports of the Ottoman Empire by employing the Engle-Granger [5], the Johansen [19] and the Johansen and Juselius [12] tests. They have used annual data for the period of 1840–1913. Evidence from the tests show that the related variables of the Ottoman Empire were cointegrated in the sample period. [6] have investigated the symmetric and asymmetric long-term relation between exports and imports for selected 100 economies. They have implemented the nonlinear ARDL as well as the linear ARDL analyses for comparing each approach. The quarterly dataset differs from country to country. Most commonly used data cover from the period from 1970s to 2015s. [6] have found symmetric long run equilibrium relationships in 60 % of the countries. They have also determined the asymmetric cointegration in 94 % of the sample.

4. Data and Econometric Methodology

4.1. Data

In this study, the long-term equilibrium association between exports (EX) and imports (IM) is investigated in the emerging and growth-leading economies (EAGLEs). The EAGLE is an acronym introduced by the Spanish bank BBVA in 2010. The members of the EAGLEs are Brazil, China, Egypt, India, Indonesia, Mexico, South Korea, Russia, Taiwan, and Turkey. According to the BBVA, the EAGLEs are expected to make a contribution to the world economic growth more than the average G6 economies (G7 excluding the U.S.) in the next decade.

For the econometric analyses I used annual dataset. The data of exports and imports are taken as the ratio in the GDP for all countries and collected from the World Bank database except for Taiwan. The Taiwanese data are obtained from the Ministry of Finance and National Statistics, The Republic of China. The dataset differs from country to country. The periods of the data are listed in Table 1 below.

Table 1

Data Period

No	Country Name	Data Period	
1	Brazil	1960	2017
2	China	1960	2017
3	Egypt	1965	2017
4	India	1960	2017
5	Indonesia	1960	2017
6	Korea	1960	2017
7	Mexico	1960	2017
8	Russia	1989	2017
9	Taiwan	1981	2017
10	Turkey	1960	2017

Examination of the external balance of the countries demonstrates that the Turkish economy has a chronic current account deficit, excluding the years of economic crisis (1994, 1998, 2001). The current account deficit has deepened since the 2000s. The high amount of energy and intermediate goods imports are arguably the primary cause for the deficit in the balance of payments in Turkey. The external balance of the Brazilian economy, on the other hand, has followed a fluctuating course. The country experienced its highest current account surplus in 2005, while the highest current account deficit was reached in 2014. In the following years, the current account deficit started decreasing; it has become positive in 2017. Similarly, Mexico's external balance, which has been on a constant deficient until the 1980s, has followed a fluctuating course after the 80s. Since the late 1990s, the current account balance has become increasingly negative. Despite having the highest share of imports and exports among the Latin America and the Caribbean, Mexico (which is a member of both North American Free Trade Agreement (NAFTA) and Free Trade Agreements (FTAs)) is highly dependent on the US in foreign trade.

The Indian economy also has a foreign trade deficit like Turkey except for a few years. The deficit, which has started to increase since the mid-90s, deepened during the 2000s and reach its peak in 2012 ($ 122.9 billion). Indonesian foreign trade balance, which followed a fluctuating course until the end of the 1990s, has experienced a continuous surplus between 1998 and 2012. But after that year, the course of the trend has changed. On the one hand, Egypt, where the service sector is predominant and the unemployment and the poverty rates have been increasing continuously with the Arab spring, has an ever-deepening current account deficit. On the other hand, Korea, which was one of the poorest countries in the world in the early of 1960s, has shown a great economic performance with the development plans implemented since 1962 and onwards with the integration of world markets. It has become one of the most important exporting countries of the world that relies on robust production, technology, and export-based growth model. Since 1998, the country, which has experienced a foreign trade deficit only during the global crisis, has consistently generated a current surplus.

The Russian economy, where the energy takes the highest share in the export items, has experienced a constant current surplus between 1989 and 2017. Likewise, as the world's largest exporting country, China has a positive external balance since 1994. Its foreign trade surplus was 215.7 billion dollars in 2017. The highest share of China's export products belongs to broadcasting equipment and computers. Finally, another country that has a current surplus in the base period of the study is Taiwan, which is also known as the Asian Tiger. Taiwan has adopted the export-oriented growth model and its primary export products are electronics, machinery, and petrochemicals.

4.2. Econometric Methodology

The cointegration defines the presence of a long-term balance or a stationary association among two or more series, each one of which separately has unit root [4, p. 158]. The term "cointegration" was initially presented by Granger [33] and then expanded and formalized by Engle-Granger [5]. In the following years, various cointegration tests were developed. One of these tests is Bound Testing Auto-Regressive Distributed Lag (ARDL) approach developed by [13]. The ARDL test has some advantages over the conventional cointegration tests. For instance, it can be used with a mixture of $I(0)$ and $I(1)$ data, so it does not need a priori knowledge of the stationarity of the series. Different variables can be allocated different lag lengths in the model. The ARDL approach enables the integration of both short and long run relationship among the variables within a unified framework [4, p. 158–163].

The ARDL technique contains 3 stages. First of all, unrestricted error correction model should be established for determining whether there is a long run relationship among the variables. If the outcome at the stage 1 is positive, the long run coefficients should be assessed in the second stage. Finally, short run dynamic effects and error correction terms should be measured. Based upon [13], unrestricted error correction model is established as following [13, p. 296]:

$$\Delta EX_t = \beta_0 + \beta_1 EX_{t-1} + \beta_2 IM_{t-1} + \\ + \sum_{i=1}^{m} \alpha_i \Delta EX_{t-i} + \sum_{i=0}^{n} \lambda_i \Delta IM_{t-i} + \varepsilon_t, \quad (4)$$

where β, α and λ are the coefficients, m and n are the optimum lag lengths. ε and Δ denote the error term and the difference operator, respectively. In order to test the cointegration relationship between the variables, the F test is used to determine whether the lagged values of the variables are equal to zero as a whole or not. The null hypothesis of no cointegration between the series cannot be rejected if calculated F-statistics is lower than the critical value described by Pesaran et al. [13]. However, if the estimated F-statistics is higher

than the critical values then the null hypothesis can be rejected. If the calculated *F*-statistic is between the upper and lower critical values of [13], then no information can be given about the long run relationship. In order to determine the long run relationship between the variables, the established ARDL (*m*, *n*) model is as below:

$$EX_t = \beta_0 + \sum_{i=1}^{m} \alpha_i EX_{t-i} + \sum_{i=0}^{n} \lambda_i IM_{t-i} + u_t. \quad (5)$$

In equation (5); β, α, and λ are the coefficients, *m* and *n* are the optimum lag lengths and *u* is the error term. The long run coefficients for the ARDL (*m*, *n*) model are calculated as in the Equation (6):

$$Long\,run\,coefficients = \frac{\lambda_0 + \lambda_1 + \ldots \lambda_n}{1 - \alpha_1 - \alpha_2 - \ldots - \alpha_m}. \quad (6)$$

After calculating the long run coefficients, the short-term dynamic interaction among the variables is established by using the error correction method (ECM) of ARDL as follows:

$$\Delta EX_t = \beta_0 + \beta_1 ECT_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta EX_{t-i} + \sum_{i=0}^{n} \lambda_i IM_{t-i} + v_t, \quad (7)$$

where β, α and λ are the coefficients; *m*, *n* are the optimum lag lengths. ECT_{t-1} represents the error correction term and *v* denotes the error term. A significant and negative coefficient of the error correction term will support the presence of cointegration.

The nonlinear long-term equilibrium based on the partial sum of the decompositions has been conducted by [34] as part of the asymmetric cointegration among the variables. In the following year, [35] have suggested the concept of "Hidden Cointegration", where the cointegration relationship may be described amongst the positive and negative components of the corresponding variables [36, p. 8]. More recently, [36] have developed a nonlinear model within the framework of the ARDL approach. The nonlinear long run regression introduced by [36] is formulized as below:

$$EX_t = \beta^+ IM_t^+ + \beta^- IM_t^- + \varepsilon_t. \quad (8)$$

$$\Delta IM_t = v_t. \quad (9)$$

In equation (8), EX_t and IM_t are the scalar *I*(1) variables. IM_t is decomposed as $IM_t = IM_0 + IM_t^+ + IM_t^-$, where IM_t^+ and IM_t^- are the partial sum processes of the positive and the negative changes in the IM_t [36, p. 8]:

$$IM_t^+ = \sum_{j=1}^{t} \Delta IM_t^+ = \sum_{j=1}^{t} \max\left(\Delta IM_j, 0\right),$$

$$IM_t^- = \sum_{j=1}^{t} \Delta IM_t^- = \sum_{j=1}^{t} \min\left(\Delta IM_j, 0\right), \quad (10)$$

where IM_t^+ is a new variable that represents only an increment in IM_t, and IM_t^- is another new variable which shows only a decrement in IM_t [6, p. 6]. The unrestricted error correction model of the nonlinear ARDL (NARDL) established for this study is:

$$\Delta EX_t = \beta_0 + \beta_1 IM_{t-1}^+ + \beta_2 IM_{t-1}^- + \beta_3 EX_{t-1} + \sum_{i=1}^{m} \lambda_i^+ \Delta IM_{t-1}^+ + \sum_{i=1}^{n} \lambda_i^- \Delta IM_{t-1}^- + \sum_{i=0}^{r} \alpha_i \Delta EX_{t-i} + \varepsilon_t, \quad (11)$$

The steps in the ARDL model are also applied to the NARDL model. In the study, both the equation (4) and the equation (11) are estimated to investigate the long run nexus between the exports and the imports. To investigate the long run tendency in the trade balance, first, exports are taken as the dependent variable within the framework of Husted's [2] study. And then, based on [3], imports are used as the explained variable.

5. Empirical Findings

In this section, both the linear and the nonlinear ARDL methodologies are employed for each of the 10 EAGLE economies. The maximum lag order is chosen via the Akaike Information Criterion (AIC). Since the data differ from country to country, 2 is selected as the maximum lag length for Russia, 3 for Taiwan and 4 for remaining countries.

The initial phase in the time series examination is to detect whether the variables are stationary or non-stationary in nature, before testing the long-term relation between two or more variables. In the ARDL test of Pesaran et al.'s [13], the variables can be used with a mixture of *I*(0) and *I*(1). However, it is important that none of the variables should be *I*(2). [13] have tabulated new critical values for both tests to calculate the integrating features of the series; thereby, it is not necessary to run pre-unit root testing on the assumption that all macro variables are either *I*(0) or *I*(1) [6, p. 6][1]. The relevant results are stated in Tables 2, 3, 4 and 5.

Table 2 presents the evidence of the optimum models, diagnostic and *F*-statistics for both the linear and the nonlinear ARDL models in which export is the dependent variable. Table 2 demonstrates there is a powerful long-term equilibrium nexus between exports and imports in 3 out of 10 countries according to the linear ARDL models. When

[1] In this study ADF unit root test is applied and it is observed from the test results that none of the variables are I(2).

Table 2

Linear ARDL and Nonlinear ARDL Model and Diagnostic Statistics When EX = f(IM)

Country	Brazil		China		Egypt		India		Indonesia	
Model	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL
	(1,1)	(2,0,2)	(2,3)	(1,2,1)	(2,3)	(2,2,3)	(1,3)	(4,4,1)	(1,1)	(1,2,0)
F-Bound statistics	3.727	4.735[c]	6.671[a]	10.44[a]	3.001	4.837[c]	2.495	3.696	9.747[a]	5.896[b]
BG LM Test	0,615 (0.53)	1.727 (0.19)	0.750 (0.48)	0.374 (0.69)	0.123 (0.88)	0.003 (0.99)	1.630 (0.21)	1.865 (0.17)	0.596 (0.56)	0.643 (0.53)
ARCH LM Test	0.844 (0.44)	1.462 (0.24)	0.180 (0.84)	0.539 (0.59)	0.657 (0.52)	0.135 (0.87)	0.571 (0.57)	1.941 (0.15)	0.081 (0.92)	0.066 (0.93)
Jarquae-Bera Test	2.977 (0.23)	5.770[c] (0.06)	7.251[b] (0.03)	4.620 (0.10)	1.195 (0.55)	0.232 (0.89)	1.805 (0.41)	0.554 (0.76)	4.575 (0.10)	2.590 (0.27)
CS (CSQ)	S (S)	S (S)	S (S)	S (S)	S (S)	S (S)	S (S)	S (S)	S (S)	S (S)
H0 Hypothesis	ACCP	RJCT	RJCT	RJCT	ACCP	RJCT	ACCP	ACCP	RJCT	RJCT

Note: BG is the Breusch-Godfrey serial correlation test, ARCH is the Autoregressive conditional heteroscedasticity test. The numbers in the parenthesis ( ) indicate the probability of statistics. The optimal lag order selected by the Akaike Information Criterion (AIC). L denotes logarithmic operator. CS and CSQ are CUSUM and CUSUMSQ tests, respectively. The critical value bounds for the F-statistics have obtained from Pesaran et al (2001) CASE III. [a], [b] and [c] denote rejection of null hypothesis at the %1, %5 and %10 levels of significance respectively. "ACCP" and "RJCT" refer to "Accepted" and "Rejected" respectively

Continued Table 2

Country	Korea		Mexico		Russia		Taiwan		Turkey	
Model	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL
	(1,1)	(2,2,1)	(3,1)	(3,1,1)	(1,1)	(2,2,1)	(2,2)	(2,2,2)	(1,4)	(1,0,4)
F-Bound statistics	4.212	5.494[b]	1.299	4.285[c]	2.245	10.30[a]	4.010	2.325	7.590[a]	6.801[a]
BG LM Test	2.597 (0.08)	0.538 (0.59)	0.763 (0.47)	0.172 (0.84)	2.693 (0.09)	0.590 (0.57)	0.521 (0.60)	0.847 (0.44)	0.041 (0.96)	0.554 (0.58)
ARCH LM Test	0.138 (0.87)	0.395 (0.68)	0.781 (0.46)	1.602 (0.21)	1.401 (0.27)	1.144 (0.87)	1.880 (0.17)	2.047 (0.15)	0.366 (0.70)	0.276 (0.76)
Jarquae-Bera Test	129.9[a] (0.00)	68.65[a] (0.00)	133.1[a] (0.00)	73.71[a] (0.00)	14.90[a] (0.00)	0.846 (0.66)	1.847 (0.40)	1.473 (0.48)	15.74[a] (0.00)	43,65[a] (0.00)
CS (CSQ)	S (S)	S (S)	S (S)	S (S)	S (US)	S (S)	S (S)	US (S)	S (S)	S (S)
H0 Hypothesis	ACCP	RJCT	ACCP	RJCT	ACCP	RJCT	ACCP	ACCP	RJCT	RJCT

Note: BG is the Breusch-Godfrey serial correlation test, ARCH is the Autoregressive conditional heteroscedasticity test. The numbers in the parenthesis ( ) indicate the probability of statistics. The optimal lag order selected by the Akaike Information Criterion (AIC). L denotes logarithmic operator. CS and CSQ are CUSUM and CUSUMSQ tests, respectively. The critical value bounds for the F-statistics have obtained from Pesaran et al (2001) CASE III. [a], [b] and [c] denote rejection of null hypothesis at the %1, %5 and %10 levels of significance respectively. "ACCP" and "RJCT" refer to "Accepted" and "Rejected" respectively.

the nonlinear models are examined, it is seen that the null hypothesis of no cointegration can be rejected for all countries excluding India and Taiwan. To put it more explicitly, there is no long run convergence between exports and imports of India and Taiwan for neither symmetric nor asymmetric models. Moreover, Breusch-Godfrey serial correlation and autoregressive conditional heteroscedasticity Lagrange Multiplier tests results show that the null hypothesis cannot be rejected at the % 5 significance level, that is to say, the models are stable. However, considering the results, the residuals are not normally distributed for some countries. The stability of the short-term and the long-term predictions is specified by employing the CUSUM (CS) and the CUSUMSQ (CSQ) tests to the residuals of each of the optimal models. The results of these two tests are presented in the diagnostic statistics section where the stable predictions are defined by "S" and unstable ones by "US". Most of them are stable, as seen in Table 2. However, for Egypt and Indonesia, the CUSUM squares of the NARDL

Table 3

Error Correction Term and Long Run Results when $EX = f(IM)$

Country	Brazil		China		Egypt		Indonesia	
	Linear	NonLinear	Linear	NonLinear	Linear	NonLinear	Linear	NonLinear
c		2.619[a]	–0.345c	2.936a		5.577[a]	–3.359[a]	5.396[a]
IM			1.191a				1.451[a]	
IM^+		0.877[b]		1.433a		0.975[a]		1.569[a]
IM^-		0.844[c]		1.592a		0.937[a]		1.608[a]
ECT_{t-1}		–0.311[a]	–0.424[a]	–0.502[a]		–0.339[a]	–0.466[a]	–0.491[a]

Note: ECT is error correction term. [a], [b] and [c] denote rejection of null hypothesis at the %1, %5 and %10 levels of significance respectively.

Continued Table 3

Country	Korea		Mexico		Russia		Turkey	
	Linear	NonLinear	Linear	NonLinear	Linear	NonLinear	Linear	NonLinear
c		2.224[a]		1.744[a]		–14.705[a]	–0.736[b]	0.623
I*M*							0.975[a]	
IM^+		1.023[a]		0.080		4.616[a]		1.038[a]
IM^-		0.715[a]		–1.058		3.492[a]		1.115[a]
ECT_{t-1}		–0.492[a]		–0.326[a]		–0.723[a]	–0.419[a]	–0.445[a]

Note: *ECT* is error correction term. [a], [b] and [c] denote rejection of null hypothesis at the %1, %5 and %10 levels of significance respectively.

model reveals slight instabilities for the periods 2003–2007 and 1998–2003, respectively. In addition, the CUSUM square result in the ARDL model of Mexico also shows some instabilities for the period from 1997 to 2003.

Table 3 shows the long run estimates and the error correction term in order to decide if there is a cointegration[1] relationship or not. Considering both the symmetric and the asymmetric ARDL approaches, the error correction terms ($ECT(-1)$) are negative as expected and also significant at 1 % for all of the countries. It means that the trade imbalances are short term phenomenon and are sustainable in the long run.

The results are country specific, as noted earlier. For instance, the linear model in the case of Turkey reveals the existence of a long-term equilibrium link between the country's exports and imports, which is contrary to [8] whose results show no evidence of cointegration relationship between the variables. The estimated value of β is nearly 1 for Turkey. That is to say, an increase in the imports by one unit is associated with an increase in the exports by 0.98 unit. According to these results, the current deficit in Turkey is sustainable. Considering the nonlinear model, an increase in the imports (particularly imports of the raw materials or the intermediate products) helps Turkey to be more exportable. In addition, a decrease in imports will damage Turkey's exports in the long-term.

In the case of Indonesia, a strong long-term connection is observed between its exports and imports, in both the linear ARDL model and nonlinear ARDL model. This result conflicts with [22], who detected no cointegration between the variables in Indonesia. Results also indicate that an increase in the imports causes increase in the exports. In addition, the nonlinear model reveals the asymmetry in the long-term impacts of the imports on the exports. An increase in the imports also increases the exports, while a decrease in Indonesia's imports is expected to hurt its exports in the long term. On the other hand, the case of Korea shows that the negative effect of imports on exports is less than the positive one.

Table 4 gives information about the calculation results of both models in which the dependent variables are imports for all countries. According to the findings of the linear model, the null hypothesis of no cointegration can be rejected for only 3 countries. Examination of the results of the nonlinear ARDL model demonstrates a long run asymmetric convergence for 7 countries. On the other hand, diagnostic test results show that the residuals are not constant for some of these countries. It is well known that if the residuals are not constant, it affects the reliability of the results. So, in order to remove the heteroscedasticity, the logarithm of the series is taken. Although the heteroscedasticity problem could not be eliminated for the linear model, it could be removed for the nonlinear models of Mexico and Taiwan.

[1] The findings of the short-term can be provided on demand.

Table 4

Linear ARDL and Nonlinear ARDL Model and Diagnostic Statistics when *IM* = *f*(*EX*)

Country	Brazil		China		Egypt		India		Indonesia	
Model	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL
	(1,2)	(1,0,4)	(3,1)	(3,1,1)	(3,1)	(1,1,0)	(4,4)	(1,1,4)	(1,1)	(4,2,0)
F-Bound statistics	1.835	6.321[b]	3.643	3.198	1.812	5.062[b]	6.807[b]	12.38[a]	13.10[a]	5.696[b]
BG LM Test	0.963 (0.39)	0.694 (0.51)	0.250 (0.78)	0.186 (0.83)	0.268 (0.76)	2.580 (0.09)	1.614 (0.21)	1.896 (0.16)	1.197 (0.31)	0.588 (0.56)
ARCH LM Test	0.060 (0.94)	0.063 (0.94)	0.201 (0.52)	0.114 (0.89)	2.114 (0.13)	2.074 (0.14)	1.312 (0.28)	1.375 (0.26)	0.953 (0.33)	3.636[b] (0.04)
Jarquae-Bera Test	42.15[a] (0.00)	128.5a (0.00)	20.80[a] (0.00)	31.29[a] (0.00)	10.76[a] (0.00)	2.772 (0.25)	2.629 (0.27)	0.878 (0.64)	9.072[b] (0.011)	3.390 (0.18)
CS (CSQ)	S (S)	S (S)	S (US)	S (US)	S (S)	S (US)	S (US)	S (S)	S (US)	US (S)
H0 Hypothesis	ACCP	RJCT	ACCP	ACCP	ACCP	RJCT	RJCT	RJCT	RJCT	RJCT

Note: BG is the Breusch-Godfrey serial correlation test, ARCH is the Autoregressive conditional heteroscedasticity test. The numbers in the parenthesis ( ) indicate the probability of statistics. The optimal lag order selected by the Akaike Information Criterion (AIC). L denotes logarithmic operator. CS and CSQ are CUSUM and CUSUMSQ tests respectively. The critical value bounds for the F-statistics have obtained from Pesaran et al (2001) CASE III. [a], [b] and [c] denote rejection of null hypothesis at the %1, %5 and %10 levels of significance respectively. "ACCP" and "RJCT" refer to "Accepted" and "Rejected" respectively.

Continued Table 4

Country	LIndonesia		Korea		Mexico		LMexico		Russia	
Model	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL
	(4,2)	(4,1,4)	(3,3)	(1,1,1)	(1,1)	(2,0,1)	(1,0)	(2,1,1)	(1,1)	(2,1,2)
F-Bound statistics	19.60[a]	9.045[a]	3.542	2.980	5.260[c]	8.297[a]	3.480	6.225[b]	3.123	33.20[a]
BG LM Test	1.512 (0.23)	0.589 (0.56)	0.713 (0.50)	2.271 (0.11)	0.184 (0.83)	0.517 (0.60)	0.662 (0.52)	0.001 (0.99)	1.608 (0.22)	0.912 (0.42)
ARCH LM Test	2.760[c] (0.07)	2.072 (0.14)	0.244 (0.78)	0.357 (0.70)	5.879[b] (0.01)	4.307[b] (0.02)	4.228[b] (0.02)	1.247 (0.30)	1.066 (0.36)	0.408 (0.67)
Jarquae-Bera Test	0.787 (0.67)	0.736 (0.69)	4.173 (0.12)	3.253 (0.20)	38.44[a] (0.00)	5.715[c] (0.06)	19.73[a] (0.00)	7.186[b] (0.03)	3.499 (0.17)	1.440 (0.49)
CS (CSQ)	S (S)	US (S)	S (S)	S (S)	S (US)	S (S)	S (S)	S (S)	S (US)	S (S)
H0 Hypothesis	RJCT	RJCT	ACCP	ACCP	RJCT	RJCT	ACCP	RJCT	ACCP	RJCT

Note: BG is the Breusch-Godfrey serial correlation test, ARCH is the Autoregressive conditional heteroscedasticity test. The numbers in the parenthesis ( ) indicate the probability of statistics. The optimal lag order selected by the Akaike Information Criterion (AIC). L denotes logarithmic operator. CS and CSQ are CUSUM and CUSUMSQ tests respectively. The critical value bounds for the F-statistics have obtained from Pesaran et al (2001) CASE III. [a], [b] and [c] denote rejection of null hypothesis at the %1, %5 and %10 levels of significance respectively. "ACCP" and "RJCT" refer to "Accepted" and "Rejected" respectively.

Continued Table 4

Country	Taiwan		LTaiwan		Turkey	
Model	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL	Linear ARDL	Non-Linear ARDL
	(2,2)	(1,1,1)	(2,2)	(2,1,1)	(1,0)	(1,4,1)
F-Bound statistics	3.796	1.651	3.926	3.240	1.890	8.102a
BG LM Test	0.993 (0.38)	1.761 (0.19)	0.856 (0.44)	0.730 (0.49)	1.222 (0.30)	0.731 (0.49)
ARCH LM Test	2.153 (0.13)	3.566[b] (0.04)	2.062 (0.14)	4.045[b] (0.03)	0.336 (0.72)	1.006 (0.37)
Jarquae-Bera Test	6.340[b] (0.04)	8.587[b] (0.01)	7.904[b] (0.02)	5.143 (0.08)	7.394[b] (0.02)	1.381 (0.50)
CS (CSQ)	S (S)	S (S)	S (S)	S (S)	S (US)	S (S)
H0 Hypothesis	ACCP	ACCP	ACCP	ACCP	ACCP	RJCT

Note: BG is the Breusch-Godfrey serial correlation test, ARCH is the Autoregressive conditional heteroscedasticity test. The numbers in the parenthesis ( ) indicate the probability of statistics. The optimal lag order selected by the Akaike Information Criterion (AIC). L denotes logarithmic operator. CS and CSQ are CUSUM and CUSUMSQ test respectively. The critical value bounds for the *F*-statistics have obtained from Pesaran et al (2001) CASE III. [a], [b] and [c] denote rejection of null hypothesis at the %1, %5 and %10 levels of significance respectively. "ACCP" and "RJCT" refer to "Accepted" and "Rejected" respectively.

Table 5

Error Correction Term and Long Run Results When *IM* = *f*(*EX*)

Country	Brazil		Egypt		India		Indonesia	
	Linear	NonLinear	Linear	NonLinear	Linear	NonLinear	Linear	NonLinear
c		3.419[a]		7.937[a]	0.089	3.230[a]	4.953[a]	11.249[a]
EX					1.172[a]		0.610[a]	
EX^+		0.035		0.686[b]		1.327[a]		0.572[a]
EX^-		0.251		0.806[b]		2.115[a]		0.562[a]
ECT_{t-1}		–0.402[a]		–0.323[a]	–0.448[a]	–0.487[a]	–0.633[a]	–0.725[a]

Note: *ECT* is error correction term. [a], [b] and [c] denote rejection of null hypothesis at the %1, %5 and %10 levels of significance respectively.

Continued Table 5

Country	Mexico		Russia		Turkey	
	Linear	NonLinear	Linear	NonLinear	Linear	NonLinear
c	–0.164	3.431[a]		41.125[a]		3.218[a]
EX	1.166[a]					
EX^+		0.463[b]		0.121[a]		0.289
EX^-		–0.199		0.236[a]		–0.151
ECT_{t-1}	–0.181[a]	–0.363[a]		–1.501[a]		–0.550[a]

Note: *ECT* is error correction term. [a], [b] and [c] denote rejection of null hypothesis at the %1, %5 and %10 levels of significance respectively.

The calculated *F*-statistics indicate that there is a long-term symmetric connection between exports and imports for 3 out of 10 EAGLE countries. At the same time, there is an asymmetric equilibrium for 7 countries of the sample. On the presence of the cointegration, estimation of the error correction models and the long run coefficients is reported in Table 5. The findings change depending on the country. For instance, the exports have no impact on the imports in the linear model for Egypt. In other words, there is no cointegration between the variables. In spite of that, the nonlinear ARDL model indicates that both an increment and a decrement in the exports have a remarkable effect on the imports. These findings are compatible with [6].

In the case of Russia, its exports and imports are cointegrated in the nonlinear model. The negative shocks of the exports are more effective on the imports than the positive shocks. In addition, the coefficient of the error correction term is –1.50. According to [37], if the coefficient of the lagged error correction term is between –2 and –1, it means that the error correction process fluctuates around the long run value in a dampening manner [37, p. 339].

6. Conclusion

This paper investigated both symmetric and asymmetric long-term equilibrium relation between exports and imports in the EAGLE economies using the annual time-series data. The ARDL test has a lot of advantages in comparison with other cointegration methods. For instance, this technique ensures strong outcomes in small sample size and does not need a priori knowledge of the stationarity of the series. In this study, I introduced the linear and the nonlinear ARDL models together for comparing them.

The findings of the present study are complex considering the previous studies. Based on the linear ARDL model, only 3 % of the sample demonstrate the existence of the cointegration. It means that the current account imbalances are sustainable in the long run and the macroeconomic policies are effective in these countries. In addition, based on the nonlinear ARDL method, the asymmetric cointegration is observed for 8 % of the countries. Judging by the econometric results, using nonlinear adjustment comparatively gives more supportive results for the long-term convergence between exports and imports.

The obtained findings suggest significant implications for policymakers of all countries. For example, the export-led economies like China are expected to grow rapidly according to the theory and eventually import more. For countries which particularly import inputs, such as Turkey, this kind of imports is expected to support economic growth.

It is important to know about the existence of a long-term relationship between exports and imports for making both current and future macroeconomic policies that aim at achieving a positive foreign trade balance. The presence of a cointegration relationship indicates that these countries do

not violate their budget constraints. Moreover, it means that the current account deficit is a short-term phenomenon and is sustainable in the long term. More clearly, macroeconomic policies are effective in balancing exports and imports. Import and export taxation should be applied carefully to ensure sustainability. Export taxes affect domestic investment and production directly; import taxes may have some effect on export. In addition to the sustainability of the current account deficit, policies that consider the impact of negative externalities created by exports and imports on domestic macroeconomic variables (for example, its effects on inflation, which has an important place in domestic resource and income distribution) should be implemented. However, countries that violate their budget constraint should replace their existing policies with more effective ones.

There are no studies that consider only the EAGLE countries. In this regard, this research makes a significant contribution to filling this gap in the field. In addition, providing information about the budget constraints of the EAGLE countries will help to implement more effective macro policies in the future. Previous studies mostly assume that the cointegration association between exports and imports is symmetric. However, the asymmetric adjustments in foreign trade flows may change the situation. To the best of my knowledge, in the related literature, there is only one study examining the asymmetric relationship. Hence in this research, the cointegration relation was revisited by updating the dataset. The findings, which are consistent with the results of [6], show that asymmetric adjustment in foreign trade for the long-term link between exports and imports is supported relatively more. Therefore, the survey will be a guide for both later researches and policy-makers implementing decisions related to external balance.

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