Industry level J-curve in Pakistan: New Evidence from Asymmetric Analysis

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CERTIFICATE

This is to certify that this thesis entitled **"Industry Level J-Curve in Pakistan: New Evidence from Asymmetric analysis"** submitted by **Mr. Mehmood Ul Hassan** is accepted in its present form by the Department of Economics and Finance, Pakistan Institute of Development Economics (PIDE) Islamabad as satisfying the requirements for partial fulfillment of the Degree of Master of Philosophy in Economics and Finance.

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DEDICATION

I dedicate this thesis to God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this Research and on His wings only have I soared.

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Mehmood ul Hassan

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ABSTRACT

This study disaggregated the trade flows to commodity level and investigated the J curve through Asymmetric approach between Pakistan and its major trading partners by covering the annual data from 1980 to 2017. The trading partners included in the study are China, Germany, Japan, Saudi Arabia, United Kingdom, and the United States. The study took 1-digit industries trade balance as a dependent variable while real bilateral exchange rate and real gross domestic product are the independent variables. In order to investigate the J- curve at industry level, both linear & nonlinear ARDL (Auto-Regressive Distributive Lag) models are used. To capture the asymmetry, the study divided the real bilateral exchange rate to two parts; Depreciation/ Devaluation and Appreciations, & separately assessed its impact on industry-level trade balance. The study finds that Nonlinear model offers more evidence in support of the short-run effect of the real bilateral exchange rate and the 'J-Curve' than what is offered by the linear model. The study concluded that the effect of devaluation on the industry-level trade balance is very weak and limited to some industries so total reliance on the external policies (devaluation/depreciation) wouldn't work to bring improvements in the trade balance. Based on the findings, the study derived important policy implications such as the elasticity approach towards the balance of payment is not profoundly effective so the policymakers should look towards the income and monetary approaches as well. secondly, NER devaluation does not always translate into the RER devaluation. Thus a policy of nominal devaluation will only be successful if it translates into real devaluation, which can only occur if the domestic prices do not increase significantly relative to the foreign prices.

CHAPTER 1

INTRODUCTION

The fluctuation in exchange rate affects the national income, trade, and the well-being of the society. The exchange rate is one of the important policy variables to control the balance of trade, hence the balance of payment, (Damirden J. and I. Pastine, 1995).

The purpose of devaluing the currency is to increase a country competitiveness in the international market and to improve its trade balance (Kabir, 2016). Devaluations or depreciation basically makes the imported goods expensive for the local and exported goods cheaper for the foreigners this leads to discouraging the import and increases the export. Consequently, the balance of trade improves, (Mohsin Bahamani Oskooee and Jehazeb Cheema, 2009) The consequences of exchange rate variation in the long run judged against the short run that leads to the J -curve theory.

By devaluing the home currency, the trade balance is expected to deteriorate at first due to sticky prices or Manu cost (contracts, pass through and the adjustment) but over time when adjustments are taken place at new prices the export volume will eventually rise and import volume will decline, hence, the balance of trade will improve in the long run, (Magee, 1973).

Alongside, this would result in higher import prices. The higher import price may put inflationary pressure on those economies which target the export enhancing strategies and import a lot of industrial capital and consumable goods, chemicals and energy resources like oil and gas. Therefore, a careful tactic is needed when dealing with the exchange rate as a policy tool, (Aye Mengistu Alemu and Lee Jin-sang, 2014).

1.1 Background of the Study

Theoretically, the real exchange rate is an essential determinant of exports and imports because it is the parameter of a country's global competitiveness. A condition known as Marshal Lerner condition affirms that " devaluation improves trade balance if the sum of imports and exports elasticity is greater than unity (Rose, 1990).

After the development of this theory, many studies were conducted for both developed and developing countries over the last 70 years. However, still, there is no agreement in the existing empirical literature about the relationship between foreign exchange rate and trade balance in developing countries. There are numerous studies that have empirically shown that currency depreciation either worsens or does not improve trade balance like the study of Miles, (1979), Bahmani-Oskooee, Mohtadi, & Shabsigh, (1991) Rose & Yellen, (1989), and the study of Agbola, (2004). On the other hand, the study of Lal & Lowinger, (2002), Aziz, (2008), Eita, (2013) provided empirical evidence which suggested that currency depreciation improves the trade balance. In case of Pakistan, the study of Bahmani-Oskooee, (1985), Bahmani-Oskooee & Alse, (1994), Aftab & Khan, (2008), Bahmani-Oskooee & Kovyryalova, (2008), Shahbaz, Jalil, & Islam, (2012), Ahmed, Awan, Sial, & Sher, (2012) and Rehman & Afzal, (2003) do not verify the presence of the J – curve. Unlike the previous studies, the study by Rehman & Afzal, (2003), Aftab, (2002) and A. Hussain & Muhammad, (2010) confirms the J- curve phenomena in Pakistan. All of these studies are based on aggregate level trade data. Studies at bilateral level that confirm the J-curve phenomenon for Pakistan include the study of Akhtar & Malik, (2000), Hameed & Kanwal, (2009), M. Hussain & Bashir, (2013) and Bahmani-Oskooee & Cheema,

(2009) but at the same time there are other bilateral level studies that do not find the evidence of J-curve in case of Pakistan with its trade partners.

Even though such haunting questions on the effectiveness of devaluation to improve the trade balance, Pakistan has made maximum use of currency devaluation with the intentions to improve the trade balance. This drill would indicate that Pakistan is more motivated to have a reliance on the pieces of evidence of devaluations to enhance trade balance and to produce quick economic growth.

The previous studies have methodological gaps, some studies which estimated false regression as conducted by the simple ordinary least square method where most of the variables have a unit root Engle & Granger, (1987). Some studies used VECM (Vector Error Correction Method) on the small size of observation thus yielding false results Toda & Yamamoto, (1995). So the need for advance econometrics techniques emerged. Another reason and the problem with previous studies was their focus on aggregate level data. The criticism on aggregate studies is large. The most meaningful criticism is getting the aggregation biasness which means that the significant price elasticity with one trading partner could be compensated by a trivial elasticity of another partner. Consequently, these existed gaps open a new research area for the study of trade elasticities. So another contribution of the study is its disaggregated data use. The study will imply industry trade of Pakistan against her major trading partner.

Above discussion concludes that all the previous studies were relying on the symmetry assumption of the exchange rate which gives the symmetric effect of appreciation and depreciation of the currency. However, there can be a nonlinear relationship. Thus, the prior assumption of symmetry can make our results false and thereby generate unreliable results. To tackle this problem, we use the nonlinear autoregressive model to capture the asymmetric effects of exchange rate on the commodity trade between Pakistan and its major trading partners.

1.2 Research Gap

There are numerous studies who empirically investigated the effect of currency depreciation/devaluation on the balance of trade. In case of Pakistan, the studies Bahmani-Oskooee, (1985), Bahmani-Oskooee & Alse, (1994), Aftab & Khan, (2008), Bahmani-Oskooee & Kovyryalova, (2008), Shahbaz, Jalil, & Islam, (2012), Ahmed, Awan, Sial, & Sher, (2012) and Rehman & Afzal, (2003) in the literature did not find significant positive effect of foreign exchange rate on the balance of trade. The reason for not finding any significant effect is because of aggregation biasness. To make the results reliable and remove the aggregation problem, we disaggregate Pakistan and its trade partner exports and imports to industry level. It will make us investigate the movements in exchange rates on the industry level balance of trade.

The second important contribution of the study is the distinction to symmetric studies that used linear models. In this study by employing a nonlinear model, we reject the symmetry assumption of the exchange rate and split the exchange rate into two parts, the depreciation, and appreciation. We came up with the idea that currency appreciations and depreciations affect trade balance in different manners, so need to be assessed on a separate basis. The reason for rejecting the symmetry assumption is based on the study of (Bussiere, 2013) who suggested that prices of exports and imports react to the movement in the exchange rate in an asymmetric manner. We believe that if the prices of traded goods respond to changes in the exchange rate in an asymmetric manner then it is natural to anticipate that exchange rate movements will affect trade balance in an asymmetric manner. Previous studies like the study of Aftab & Khan, (2008), Bahmani-Oskooee & Cheema, (2009) by keeping the symmetric assumption did not verify the real exchange rate effect on Pakistan trade balance. In these studies, it was found that currency depreciation adversely affects Pakistan trade balance. However, there is no evidence that can support the view that rupee appreciation generates an opposite and equitant effect. We doubt that the effects of the exchange rate are asymmetric in nature. For that purpose, commodity trade of Pakistan with her six major trading partners both in the linear and nonlinear framework is being analyzed in this study.

1.3 Objectives of the Study

Based on the above discussion, the study generated the following objectives:

- To investigate the industry level J-curve in Pakistan against her major trading partners through the symmetric approach.

- To investigate the industry level J-curve in Pakistan against her major trading partners through the asymmetric approach.

- To investigate the income effect on industry level balance of trade.

1.4 Significance of the Study

Though, in what way industries retort to the dynamics of the exchange rate cannot be concluded from the studies of aggregate trade balance behavior. so disaggregating the trade balance data to commodity level is a need of time, it has benefits like the industries trade balance exploration assist policymakers to know the magnitude and direction of each industry reaction to change in exchange rate.

We hope this study improves our understanding of the dynamic effects of exchange rate changes on Pakistan Industry level trade balance. It will also assist to policymakers that to what extent the real exchange rate changes shall be applied to design, control, and forecast and to manipulate in the trade flows between Pakistan and its major trading partners. Furthermore, whether the exchange rate can be a good indicator to improve the trade balance & give a reference to the central bank in the policy-making decision and for further research in this area.

1.5 Organization of the Study

After this first introductory chapter, this study is organized in the following way. Chapter two present the theoretical background of the study. Chapter three consists of the empirical literature review on the J curve. Chapter four concentrates on the methodology, i.e. econometric techniques and the sample data that are used in estimation in search of the symmetry and asymmetry of the exchange rate and the J curve in Pakistan’s trade with her major trading partners. Chapter five focus on the analyses of the estimated empirical results of the model. Lastly, the summary of the main findings, limitations, policy recommendation and the conclusion of the study is given in chapter six.

CHAPTER 2

CONCEPTUAL FRAMEWORK OF J-CURVE

2.1 Introduction

In this chapter, the conceptual framework of the J - curve is given. We discuss the diverse patterns of the trade balance that can take place due to the changing exchange rate. The conditions under which J-curve is permissible and those, under which it can't be accommodated, are also addressed in this chapter.

2.2 J curve- an Alphabetical Phenomenon

It takes some time to observe the Marshall Lerner condition, where j-curve emerges in the short run period. The economic agents don't alter their behaviors instantly during relative price changes hence the trade balance shows worsening manner but will improve slowly over time when the agents get familiar the altering situations. The situation will provide the J curve shape of the trade balance (Sørensen & Whitta-Jacobsen, 2005)

It becomes very difficult to grasp the pegged exchange rate in the situation when the amount of private capital mobility is more than the reserves of the central bank (Magee, 1973). He categorizes the issue in three short run time periods to get an appropriate identification of these alterations generating patterns of trade balance.

- The currency contract period
- The pass-through contract
- The quantity adjustment period

2.2.1 The currency Contract Period

It is the period when the contract is signed before currency devaluation. As the fluctuating exchange rates can have either a positive or negative effect on trade contract. The exporter wills to sign a contract in the currency which is likely to be appreciated, whereas the importer wills to sign a contract in the currency which is likely to be depreciated. Keeping in mind both these conditions, Magee categorizes 4 general cases. He says that imports contracts should be signed in foreign currency to examine the undesirable effect of devaluation on the trade balance in the initial stages. The classification system of Magee tells that there is only one case out of the four cases where The J curve can't be evaded. In total, there are two out of four cases where the condition for the J curve is feasible.

Magee's categorization system also recognizes that in only one out of four cases is a corrosion (J-curve) of the Trade Balance predictable, and in total, possible in only two of the four cases, provided that the Trade Balance is measured in dollars (home currency).

2.2.2 The Pass Through

This period is concerned with the contract that was signed after the devaluation and still, the exports and imports have not changed in the short run. This period entails the impact on the price of foreign good after devaluation. The purchase pattern will rely on how the prices have been altered which themselves depend on how much the exporter pass through the devaluation on the prices. Now the question is why the quantities have not tuned in this period? There are two possible reasons for this malfunction. The first reason is the entirely inelastic supply as the suppliers are not competent to immediately increase their sales abroad. The second feasible reason is the entirely inelastic demand, as the importers can't find a surrogate for the imported goods instantaneously. Here, if the demand for US product is somewhat elastic and the supply of the US product is inelastic, then the devaluation will have no impact on the price in foreign for US goods. So, there will be no amend in the foreign demand curve for US goods and there will be no pass-through effect.

In distinction, if the demand is inelastic and supply is slightly elastic, then the price will stay alike in dollars but will drop in respect of foreign currency and there will be a full pass effect. The same is the case for the importers, where there will be no pass effect if the supply of export is entirely inelastic, and there would be passing through if the demand is entirely inelastic. Magee explains four cases of the effect of devaluation on the trade balance in the short run. He portrays the worst situation for the US trade balance when there is inelastic demand for US exports and inelastic demand for the US imports. The most favorable and best situation for the US trade balance will be when there is inelastic demand for US exports and imports (Magee, 1973).

2.2.3 The Quantity Adjustment Period

The currency contract period and the pass-through period are those where quantities don't vary. Now, in the quantity adjustment period, the quantity starts to fiddle with the new situation. In Pass through, the short run demand curve is thought to be inelastic and it will influence the adjustment period. This adjustment will decrease the value of US exports and will originate the fall in US imports due to the devaluation. The trade balance can show a different prototype in the short run in dissimilar periods. As shown earlier, the trade balance falls in a currency contract period, rise in Pass-through, and again decline in the quantity adjustment period. This was the rationale that Magee launched the W curve (Magee, 1973)

2.3 The Lagged Economic behavior- the Case of the Pattern

(Junz & Rhomberg, 1973) specify several categories of lags for the idea to clarify the long run adjustment period that imports and exports necessitate after devaluation and changes in relative prices. This work gives the impression to be the extension of the (Magee, 1973) work. The first one is the identification lag and implies that a timed lap is necessary for economic agents after altering conditions to adjustments in relative prices. The lag is normally believed to be much gigantic in international trade as compare to domestic one because of some distance and language barriers. Establishing new business relations, employing in contacts and location order constitute the second lag titled as decision lag. The nature of the article of trade decides the third 'delivery lag' demonstrating the time surpass between furnishing and deliverance of the order. The statistics get some impediment because the compensation is received after delivery.

The inventory or expire machinery prior to stock is substitute hence the fourth lag is named as replacement lag. Lastly, the fifth and production lag involving new industry establishment or operating the old closed industry can't raise the production for market supply instantaneously after starting their operations. For increasing supply, the factors should induce increased revenues by increased relative prices. Finally, the writer preferred to analyze yearly data in spite of quarterly data (Junz & Rhomberg, 1973).

CHAPTER 3

LITERATURE REVIEWS

3.1 Introduction

In this chapter, the literature review on the J curve is given. The empirical literature review on the J curve is divided into two main sections i.e. the symmetric studies, which include the aggregate studies, the bilateral studies, the commodity/industry level studies and studies on Pakistan. The second section is about asymmetric studies which include different studies where the nonlinear models are used. In the end, the brief overview of all types of study is given.

3.2 Symmetric Studies

3.2.1 Aggregate Studies

The exchange rate is considered the most important determinant of trade balance. to test this proposition, (Miles, 1979) empirically shown the validity of the global monetarist proposition for 14 countries. (Bahmani-Oskooee, 1985) tested the J curve for India, Greece, Korea, and Thailand and found that depreciation improve trade balance in short run for only Thailand but in long run, it has a negative effect on the trade balance for all countries. (Bahmani-Oskooee, 1985) redefined the exchange rate as the unit of domestic currency per unit of foreign currency and the J curve, he found inverse J curve for the set of countries except for Thailand where the J curve phenomenon exists.

Latterly, in order to explain the impact of devolution on the trade balance the devaluation’s non-influencing attitude over trade balance with nominal as well as real exchange rates and observed the close relationship between the two exchange rates (Himarios, 1989). The trade balance was studied as a function of the opportunity cost of holding money, the real exchange rate, government expenditure, and real income. The J curve was seen just for the UK. in the first sample of 1953-1973. Then for the second sample 1975-1984, the nominal exchange rate replaced the real in the previous equation and the J curve was seen for Zambia, Greece, France, and Ecuador.

However, (Rose, 1990) Introduced a nonstructural model employed trade balance as a function of domestic income, foreign income and the real exchange rate for over thirty counties including Turkey and discovered non-significance of the real exchange rate over trade balance for 28 countries and has a significant impact in Tanzania and Tunisia. However, (Rose & Yellen, 1989) using nonstructural model, examines this for five OECD countries UK, Canada, Germany, Japan, and the US by using extensive econometric techniques but even then the significantly influential relation was not observed for trade balance and exchange rate concluding that the ML situation doesn't exist.

Criticizing the studies for using data of macroeconomic variable with a unit root, (Bahmani-Oskooee & Alse, 1994) compare the study of (Miles, 1979) and (Himarios, 1989) and (Bahmani-Oskooee, 1985) by using the first difference stationary data and non-stationary data respectively in their researches. According to him the results with non-stationary data may be biased and they suggest that the study, such these studies should be overlooked. For examining the short run and long-run impact of exchange rate on the trade balance for 19 developed and 22 less developed countries (Bahmani-Oskooee & Alse, 1994) found that devaluation improve the trade balance of Turkey, Singapore, Ireland, Costa Rica, Brazil, and the Netherlands and have a suppressing consequence on Ireland's trade balance. Then after imposing the ECM for Costa Rica, Singapore, and Ireland along with Turkey, a J curve was observed with primary worsening and then progressing trade balance. However, in distinction to previous studies, (Lal & Lowinger, 2002) predicted a weak evidence for J curve using nonparametric statistical approach and non-linearity criteria for trade balance behavior employing the exchange rate, cross countries GDP, and current account. (Shahzad, Nafees, & Farid, 2017) investigated the effect of exchange rate depreciation on the trade balance in South Asia using panel data unit root and the Pedroni cointegration method and found no long-run relationship between exchange rate depreciation and the trade balance in the South Asia region.

3.2.2 Bilateral Studies

The first study, which uses the bilateral trade data is the one conducted by (Rose & Yellen, 1989) criticize the using the aggregate level and prior findings and investigates the J curve for the American economy. The trade balance was taken as a function of domestic income, foreign income, and real exchange rate. In the same study, the results obtained for aggregate data demonstrated J curve existence for America while the bilateral level study doesn't show J curve existence. In a similar pattern of study, (Wilson & Tat, 2001) studied the trade relation among Malaysia, Korea, Singapore with Japan and the US taking up ARDL approach and Instrumental Variable technique (IV) to remove simultaneity issue and observed the significance of real exchange rate over trade balance of Singapore, Malaysia and Korea but J curve was found only for Korean economy.

Arora, Bahmani-Oskooee, & Goswami, (2003) investigated the impact of the depreciation of the Japanese Yen on its bilateral trade with its major trade partner (Australia, Germany France, Canada, Italy, US, UK, Netherlands, and Switzerland) and found that J curve exists for Italy and Germany and positive impact of real exchange rate on the trade balance in the long run for Canada, the US, and the UK. By using the same methodology, (Bahmani-Oskooee & Wang, 2006) detained the contact of depreciation on UK trade balance. By using the bilateral trade data of the UK with its 20 trading allies and found the J curve only in US and Canada. They also observe the progress in the trade balance for the six countries, including Australia, Greece, Austria, South Africa, Spain, and Singapore.

Narayan, (2006) discovered co-integration between China's trade balance and its trade with the USA using ARDL model and observed an improvement in China trade balance with depreciation. However, found no evidence of the J - curve. In a similar study (Bahmani-Oskooee, Economidou, & Goswami, 2006) investigated J curve between China with its 13 trade allies and found it only with Hong Kong and the UK, to check the feedback among variables in this study, they use Johansen's (1988) cointegration approach and find cointegration for all countries. To capture the J curve phenomenon after finding the feedback among variables, they use generalized impulse response function and find no evidence of the J curve except for Singapore. The exchange rate was seen as significant for trade balance in the short run, and co-integration for all the countries.

3.2.3 Commodity/Industry Level Studies

The disaggregate level studies of (Ardalani & Bahmani-Oskooee, 2007) stands as an example where he paid attention to monthly data and investigated the J curve for 66 US trading industries and found J curve for six industries and a long run direct relation for 22 industries between real depreciation and trade balance. Similarly, the study of (Breuer & Clements, 2003) who took 58 industries data and analyzed industry trade between Japan and the US. The study discovered that exchange rate is significant for export of 40 industries and for the imports of 24 industries as export-related industries are more responsive to the exchange rate as compared to imports, and devaluation caused US trade balance deficit.

By utilizing the data of 177 industries (Bahmani-Oskooee & Kovyryalova, 2008) found a considerable short-run association between exchange rate and trade balance in 60% industries but found no definite outline of J curve. However, the J curve was observed for many industries according to its new definition. In a similar study (Bahmani-Oskooee & Mitra, 2008) took data for 38 industries trade balance of India with the US to analyze real depreciation impact and found J curve for 3 industries according to Magee definition and for 8 industries according to Rose and Yellen definition. A significant short-run effect of depreciation on trade balance of Malaysian trade with Japan using 67 industries was examined by (Soleymani, Chua, & Saboori, 2011) using ARDL and ECM model, their empirical results support J curve only for 22 industries. Korean exports and imports were found more responsive than of Japan in the short run and less in the long run.

3.2.4 Studies on Pakistan

In Pakistan, the exchange rate is always being used an important factor to enhance exports and reduce imports. To investigate whether trade balance is affected by exchange rate or not (Hameed & Kanwal, 2009) investigate J curve in Pakistan in its trade with ten major trading partners and found that there is no evidence of J curve and concluded that the depreciation is not the effective policy for developing countries to improve its trade balance as it further widens the gap. Their results also reveal that foreign income plays a vital role in improving the trade balance of Pakistan. (Bahmani-Oskooee & Cheema, 2009) also explored the impact of exchange rate changes on trade balance and employed ARDL model to capture the long run and short run impact and have found no evidence J curve and concluded that depreciation will deteriorate the trade balance.

Jalil, Abbasi, & Bibi, (2016) by employing the ARDL approach to cointegration concluded that there is long-run relationship among the variables and significant negative coefficients. However, they do not observe the evidence of the J curve. While for the investigation of the J curve in Pakistan, (Rehman & Afzal, 2003) like the other studies, fails to support the J curve theory in Pakistan's trade data. They further added that the J curve theory can only be held when the exports and import demand are elastic and most of Pakistan's imports consist of necessities and show less response to the changes in exchange rate. Their results also show that depreciation will increase the import bill and will increase the debt burden.

Iqbal, Nosheen, Tariq, & Manan, (2015) analyzed the Marshall Lerner condition between Pakistan and its major trading partners. The trading partners included in their study are the UK, Saudi Arabia, China, Japan, Kuwait, UAE, the US, Canada, France, and Germany. Johansen Juselius cointegration test has been applied. The results of their study suggest that the Marshall Lerner condition is satisfied for six countries, Canada, US, China, Saudi Arabia, France, and the UK, while there is no indication of Marshall Lerner condition for the remaining four trading partners. (Bahmani-Oskooee, Iqbal, & Muzammil, 2017) investigated the short and long-run effects of currency depreciation on the commodity trade between Pakistan and EU. Their study has an important contribution to trade literature as unlike previous studies, they disaggregated the data to 77 industries that trade between Pakistan and EU. The findings of their study suggest that 22 industries are being affected by currency depreciation but in the long run, this effect does not last. Most of the affected industries are found to be small, as measured by their trade shares.

3.3 Asymmetric Studies

The literature on trade balance has been developed by believing the view that the exchange rate may have an asymmetric effect. for this purpose (Chinn & Frankel, 1991) by employing different econometric techniques came to the conclusion that the relationship between the exchange rate and the trade balance is nonlinear. (Lin & Fu, 2015) observed the nonlinear relationship between the two variables, i.e. exchange rate, and trade balance. The study included the ratio of exports and imports, real exchange rate, consumer price index and the national income of both countries five to observe the bilateral trade concept and to incorporate the nonlinear effect of exchange rate on trade balance the author used REX_{-2}. The author based on the results of Johansson cointegration test found that the relationship between RER and the trade balance is nonlinear and the RMSE has better forecasting results.

To tackle the problems in previous studies, (Jibrilla Aliyu & Mohammed Tijjani, 2015) used monthly data and examined the asymmetric relationship between exchange rate and trade balance in Nigeria. Threshold cointegration and asymmetric ECM (Error Correction Model) results confirmed the negative relationship between these variables.

Qayyum, Nazir, & Jawad, (2016) empirically examined the nonlinear relationship between the exchange rate and the bilateral trade between Pakistan and the United States. The study-proven that the relationship between RER and trade balance in the bilateral trade between Pakistan and United States based on the Negative sign of REX_{-2} and confirmed the existence of J curve as the short run negative coefficients of exchange rates are followed by positive coefficients. The study suggests that nonlinear model forecast is better than the linear models examined by the RMSE and MAE. (Bahmani-Oskooee, Bose, & Zhang, 2017) examined the symmetric and asymmetric effects of exchange rate on the bilateral trade of China and 21 trading partners. by employing the linear model by (Rose & Yellen, 1989) and the nonlinear model by (Bahmani-Oskooee & Fariditavana, 2016). The study finds that nonlinear ARDL shows significant effect in most of the countries while the linear ARDL do not give much importance to the effect of exchange rate on the de balance. Rejecting the symmetry assumption, an industry level study of (Soleymani et al., 2011) who analyzed the exchange rate volatility on trade balance of Malaysia and China by coming with the view that its impact can be asymmetric based on the behavior and expectations of trading partner towards the currency depreciation and appreciation.

Bahmani-Oskooee & Harvey, (2017) studied the trade balance of Malaysia and her top trading partners at the bilateral level. Like the previous studies, he came up with the view of asymmetry in the manner of the exchange rate effect on the trade balance. Nonlinear ARDL model is used to check the short and long-run effects of currency appreciations and depreciation. The study found adjustment asymmetry, short and long-run impact asymmetry in the bilateral trade between Malaysia and Asian countries. After the development of ECM and cointegration, the j-curve as defined as short-run deterioration and long-run improvements has changed. the standard models like the ARDL approach of (Pesaran, Shin, & Smith, 2001) suppose the relationship between economic variable as linear. But the study of (Bahmani-Oskooee & Fariditavana, 2016) on the bilateral trade of the United States and its top selected trading partners assumed that the relationship is nonlinear in nature. The study finds more evidence in support of the J curve as compared to the linear models.

3.6 Overview of the Literature

The literature on the J curve consists of two types of studies, i.e. Symmetric, and Asymmetric studies. The symmetric studies in the literature have employed aggregate trade data, bilateral trade data and few have used the commodity/industry level data. Their findings, however, are mixed and ambiguous and don't give a specific pattern of the J curve. The second type of studies in the literature believes that the relationship between the exchange rate and the trade balance is nonlinear. In case of Pakistan the earlier studies have either used aggregate trade data or have employed bilateral trade data emphasizing on the symmetry assumption, but no one has attached importance to the view that the relationship can be nonlinear at commodity /industry level. So in this study, we are disaggregating Pakistan's trade at commodity level and investigating the J curve both in linear and nonlinear framework between Pakistan and its six major trading partners.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

In this chapter, the empirical framework through which the objectives of the study are carried is given. The chapter includes four sections. In the first section, the model for trade balance is discussed. The econometric techniques containing unit root test, bound testing approach to cointegration and Error correction model are discussed in the second section. The brief overview of the data and its sources are discussed in section three. Section four is about the description of the variables.

4.2 Econometric Techniques

Several econometric techniques are used in this research study with the aim to investigate the J curve in the trade between Pakistan and Trading partners. These econometric techniques are briefly discussed in the following section.

4.2.1 Stationarity of the Time Series

According to (Granger & Newbold, 1974) the common statistical test may find a relationship between the two non-stationary variables which will give the false relationship and spurious results. After this finding, the researchers became cautious about the non-stationary series and conclude that it is necessary that one should know about the characteristics of the series. The stationarity of the variables in the model appears when the Mean, Variance of the model are same or constant and the covariance between the observations should not depend on the point of time at which they are considered but should depend on the length of the period between them. And the non-stationary desires the situation that Mean and Variance are not constant. To confirm whether the series is stationary or not, the scholars check the unit root of the series by employing Augmented Dickey fuller unit root test.

4.2.1.1 Augmented Dickey-Fuller Test

It is important to check the stationarity of the time series data set before applying the different test and econometric techniques. There are numerous tests which researchers use to check the unit root of the data, e.g. Philips Perron (PP), Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF). The typical and commonly used technique of unit root test namely the Augmented Dickey-Fuller test, henceforth ADF test was engaged as a prior diagnostic test before the estimation of the model as it is simple, easily understandable and used in most research studies.

The hypostudy for ADF test areas

Null hypostudy

H0: The data has a unit root

Alternative hypostudy

H1: The data doesn't have unit root i.e. stationary.

If the data possess the unit root, then we check its order of integration by taking differences. If the data become stationary after taking the 1st difference, then we say that the variable is integrated of order one and denote it as I (1). If the series is integrated of d times to make it stationary, then it is said to be integrated of order d, i.e. I (d).

The ARDL cointegration technique can be used irrespective of the order of variable. However, the need for testing the variable stationarity is still there because we can't use ARDL if the variables are integrated of order two (Jalil et al., 2016). There is numerous test unit root in the time series data specifically the Augmented Dickey-Fuller (ADF) and Phillips Perron. In the present study, we employed the ADF test. The results of the ADF test show the mixed order of integration for all the variables, i.e. I (0) and I (1) therefore, we can move towards ARDL as an appropriate cointegration technique.

4.2.2 Autoregressive Distributed Lag Model to Cointegration

For the J curve phenomenon, it is necessary that short-run coefficients must be followed by the significant positive coefficients in the long run. For this purpose, first, it should be confirmed that whether there exists cointegration among the variables or not. If the cointegration exists, then we need to proceed with short and long-run results.

In order to investigate the symmetric effects of exchange rate both in short and long run, we use a linear model of (Pesaran et al., 2001) recognized as an Autoregressive distributive lag model (ARDL) which is also known as a bound testing approach to cointegration. Following are the advantages of using this methodology

The first and the most important advantage of the ARDL approach to cointegration is that it has no requirement of the same order of integrated variables. The 2nd advantage of the ARDL methodology is that it gives short and long-run estimates, which are necessary for the analyses of the J curve. Similarly, according to Baek (2006) ARDL has a proper number of lags which capture the best response of the variable. Pesaran and Shin (1999) believe the ARDL approach is better for the small sample size as compared to the other cointegration techniques and give robust results.

For empirical analysis, the study uses both linear and nonlinear approaches. For the linear model, we follow (Rose & Yellen, 1989) and the nonlinear model (Bahmani-Oskooee & Fariditavana, 2016). Following is the long run specification of our model.

$$LnTB_{i,t} = a + bLnY_{PAK,t} + cLnY_{i,t} + dLnREX_{i,t} + \epsilon_{t,t} \quad \text{..................................(1)}$$

For the short run effects, the above equation is modified according to the Error correction framework.

$$\Delta LnTB_{i,t} = \alpha + \sum_{j=1}^{n} \beta_j \Delta LnTB_{i,t-j} + \sum_{j=0}^{n} \delta_j \Delta LnY_{PAK,t-j} + \sum_{j=0}^{n} \gamma_j \Delta LnY_{i,t-j} + \sum_{j=0}^{n} \pi_j \, \Delta LnREX_{i,t-j} + \lambda_1 LnTB_{i,t-1} + \lambda_2 LnY_{PAK,t-1} + \lambda_3 LnY_{i,t-1} + \lambda_4 LnREX_{i,t-1} + \mu_{t,t} \quad \text{...(2)}$$

Equation (2) has an advantage over the equation (1) which is the standard error correction model. This equation let us use the one-step OLS procedure to capture the short and long run relation among the variables. The short-run estimates are with first difference sign while $\lambda_2 - \lambda_4$ are the long run coefficients where it is normalized estimates of λ_1. It is necessary for the long run coefficients to be true and meaningful that there must be cointegration among the variables. F test is recommended by (Pesaran et al., 2001) to make a combined significance for the linear combination of 1st lag variables to give an evidence of cointegration and for the large sample size, a set of tabulated critical values is offered. In this study, we use critical values offered by (Narayan & Narayan, 2005) due to small sample size. In some cases, when F test cannot be held and gives inconclusive results, we refer to the ECM version of the ARDL suggested by (Kremers, Ericsson, & Dolado, 1992).

4.2.3 Nonlinear Autoregressive Distributed Lag Model to Cointegration

The main assumption in the linear framework presented in equation (1) and (2) is that the movements in exchange rate effect trade balance in a symmetric manner. To be more precise, it was assumed the currency appreciation and depreciation has the same elasticity over trade balance. But we believe that the exchange rate affects the trade balance in an asymmetric manner following Shin et al (2014). For that purpose, we separate currency depreciation from appreciation by using partial sum concept. Secondly, in order to represent the rupee appreciations and depreciation, we produce Δ indicating the rate of change in the exchange rate.

$$POS_t = \sum_{j=1}^{t} \Delta LnREX_j^{+} = \sum_{j=1}^{t} \max(\Delta LnREX_{j,} 0),$$

$$NEG_t = \sum_{j=1}^{t} \Delta LnREX_J^{-} = \sum_{j=1}^{t} \min(\Delta LnREX_J, 0) \quad \text{.........(3)}$$

The partial sum of currency appreciation is represented by POS_t, while NEG_t stands for partial the sum of currency depreciations. Substituting these values make us reach the following specification of the nonlinear model.

$$\Delta LnTB_{i,t} = \acute{a} + \sum_{j=1}^{n1} \acute{b}_j \Delta LnTB_{i,t-j} + \sum_{j=0}^{n2} \acute{c}_j \Delta LnY_{PAK,t-j} + \sum_{j=0}^{n3} \acute{d}_j \Delta LnY_{i,t-j} + \sum_{j=0}^{n4} \acute{e}_j \Delta POS_{t-j} + \sum_{j=0}^{n5} \acute{f}_j \Delta NEG_{t-j} + \theta_0 LnTB_{i,t-1} + \theta_1 LnY_{PAK,t-1} + \theta_2 LnY_{i,t-1} + \theta_3 POS_{t-1} + \theta_4 NEG_{t-1} + \in_{i,t} \quad \text{................(4)}$$

Equation (4) represents the specification of the nonlinear model as opposed to the linear model in equation (2). Shin *et al.* (2014) suggested that in case of the nonlinear model given in equation (4) the same critical values presented by (Pesaran et al., 2001) for the linear model can be used in testing the cointegration. Furthermore, the use of same critical values due to the dependency between the two partial sum variables is possible in the F test.

$$\Delta LnTB_{i,t} = \acute{a} + \sum_{j=1}^{n1} \acute{b}_j \Delta LnTB_{i,t-j} + \sum_{j=0}^{n2} \acute{c}_j \Delta LnY_{PAK,t-j} + \sum_{j=0}^{n3} \acute{d}_j \Delta LnY_{i,t-j} + \sum_{j=0}^{n4} \acute{e}_j \Delta POS_{t-j} + \sum_{j=0}^{n5} \acute{f}_j \Delta NEG_{t-j} + \theta_0 LnTB_{i,t-1} + \theta_1 LnY_{PAK,t-1} + \theta_2 LnY_{i,t-1} + \theta_3 POS_{t-1} + \theta_4 NEG_{t-1} + \in_{i,t} \quad \text{................(5)}$$

Equation (4) estimates propose an opportunity to test the symmetry of exchange rate along with several dimensions. For instance, ΔPOS and ΔNEG different lag structures put light on the short run adjustment asymmetry of currency appreciation versus the depreciation on the trade balance. Similarly, we get to know the differences in the direction and magnitude of currency appreciation and depreciation effect on the trade balance by the estimates of ΔPOS and ΔNEG. The existence of impact asymmetry or short-run cumulative can be confirmed by rejecting a null $H_0: \sum \widehat{e'}_j = \sum \widehat{f'}_j$ finally, the exchange rate long-run asymmetric effects can be verified if the null $H_0: -\hat{\theta}_3/\hat{\theta}_0 = \hat{\theta}_4/\hat{\theta}_0$ in favor of an inequality.

4.3 Sources of the Data

Based on the availability of the data, we select data for the period of 1980-2017. The countries included in the study are China, Germany, Japan, Saudi Arabia, United Kingdom, and the United States. The data for a different variable is obtained from the followings two sources.

1. Word development indicator (WDI)
2. World integrated trade solutions (WITS)

The data for the nominal exchange rate, inflation (CPI) and real gross domestic product for Pakistan and all of its trading partners is taken from world development indicator (WDI), whereas the data on commodity trade flows are taken from the World Bank database; the World Integrated Trade Solution (WITS). The WDI is well known to everyone, but WITS is not so common. So, we briefly discuss the WITS source in the following section.

4.3.1 Wits-UNSD Comtrade

WITS is a World Bank website that provides the bilateral data of trade and tariff of all the countries. It uses UNSD COMTRADE (United Nation Statistics Division Commodity trade) database as a data provider which holds a huge amount of information on different nomenclature and provides free data with a limit of 50,000 rows per download.

4.4 Descriptions of the Variables

The variables under study are discussed in the following section.

4.4.1 Trade Balance

The trade balance (TB_i) is defined as the ratio of the dollar value of Pakistan export of i_{th} commodity to trading partners to the dollar value of Pakistan's imports from trading partner's imports of i_{th} commodity($^X/_M$). We have followed the work of Bahmani-Oskooee and Hajilee (2009) and Bahmani-Oskooee and Harvey (2010). This method has two advantages, 1st it is unit free. Secondly, this method has no issue of taking logs as the trade balance is in ratio form rather than in absolute values. the present study, took 1-digit industries that trade between Pakistan and her major trading partners.

4.4.2 Income of the Countries

Real Gross domestic product (RGDP) has been used as a proxy of income in the present study. It is defined as the total value of all final goods and services produced within the geographical boundaries of Pakistan and other trading partners.

4.4.3 Real Bilateral Exchange Rate (RBER)

Different types of exchange rates are used in the previous studies, e.g. the real effective exchange rate, the nominal effective exchange rate, and the real bilateral exchange rate.

The bilateral exchange rate is useful in this research work as it measures the goods prices of one country in terms of another country's good price. The bilateral exchange rate is defined as $\boldsymbol{REX_i} = (P_i . {}^{NEX_i}/_{P_{Pak}})$ where $\boldsymbol{NEX_i}$ is the nominal exchange rate defined as Number of units of partner i's currency per Pakistani Rupee, $\boldsymbol{P_i}$ is the price level in country $\boldsymbol{i}$ (also measured by CPI) and $\boldsymbol{P_{Pak}}$ is the price level in Pakistan (as Measured by CPI). Thus, a decline in $\boldsymbol{REX_i}$ reflects a real depreciation of the Rupee. Guechari (2012), Mohammad and Hamza (2012), and many other studies have used the real bilateral exchange rate in their study.

CHAPTER 5

ESTIMATION RESULTS

5.1 Introduction

The main objective of this chapter is to discuss the results of different estimation techniques used in this study in order to investigate the commodity/industry level J curve through symmetric and asymmetric approaches. This chapter is distributed into four main sections. The first section presents the results of unit root test. The results of the bounding testing approach to cointegration are given in the second section. The third section presents the results of short and long-run effects of currency appreciation and depreciation consequently the detection of the J curve and finally the impact of economic activities on the trade balance. The fourth section is about the diagnostic statistics.

5.2 Unit Root Test Results

Table 1: ADF test results of Pakistan and Saudi Arabia industry level trade

Variables	Level		1st difference		Conclusion
	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
$\ln REX_{i,t}$	0.0171	0.0623	-	-	I(0)
POS	0.3809	0.0030			I(0)
NEG	0.8999	0.1565	0.0000	0.0000	I(1)
$\ln Y_{PAK}$	0.0132	0.7420	-	-	I(0)
$\ln Y_{SAU}$	0.9726	0.0294			I(0)
lnAVOF	0.1375	0.0000			I(0)
lnBT	0.4422	0.4061	0.0000	0.0017	I(1)
lnCHM	0.0119	0.1505			I(0)
lnCT	0.0034	0.0056			I(0)
lnCMIEF	0.0587	0.0310			I(0)
LnFLA	0.0000	0.0003			I(0)
LnMTE	0.0481	0.0630			I(0)
LnMGC	0.3723	0.1669	0.0000	0.0001	I(1)
LnMFL	0.0708	0.2321			I(0)
lnMMI	0.0209	0.0052			I(0)

The variable $\ln Y_{PAK}$ (log of Pakistan real GDP), $\ln Y_{SAU}$ (log of the Saudi Arabia real GDP), $\ln REX_{i,t}$ (real bilateral exchange rate), POS (partial sum of the Rupee's appreciation), lnAVOF (log of Animal and vegetable oils and fats industry) lnCHM (log of chemical industry), lnCT (log of Commod. & transacts. Not class. Acc industry), lnCMIEF (log of Crude materials, inedible, except f), lnFLA (log of food and live animals industry), lnMTE (log of Machinery and transport equipment industry), lnMFL (log of Mineral fuels, lubricants and relat industry) and lnMMI (log of Miscellaneous manufactured industry) are stationary at level, i.e. I (0). While NEG (Partial sum of the rupee's depreciation), lnBT (log of Beverages and tobacco industry) and lnMGC (log of Manufact goods classified chiefly b industry) are non-stationary at level but are stationary at the 1st difference, hence I (1).

Table 2: ADF test results of Pakistan and Japan industry trade

Variables	Level		1st difference		Conclusion
	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
$\ln REX_{i,t}$	0.3300	0.8947	0.0004	0.0005	I(1)
POS	0.2453	0.6758	0.0001	0.0004	I(1)
NEG	1.0000	0.8695	0.8757	0.0003	I(1)
$\ln Y_{PAK}$	0.0132	0.7420	-	-	I(0)
$\ln Y_{JPN}$	0.0003	0.6853			I(0)
lnAVOF	0.0000	0.0001			I(0)
lnBT	0.0000	0.0000			I(0)
LnChm	0.0245	0.0325			I(0)
lnCt	0.1299	0.2514	0.0000	0.0000	I(1)
lnCMIEF	0.0386	0.0238			I(0)
LnFLA	0.0269	0.1064			I(0)
LnMTE	0.0000	0.0002			I(0)
LnMGC	0.1339	0.0954			I(0)
LnMFL	0.0000	0.0000			I(0)
LnMMI	0.5039	0.4146	0.0000	0.0000	I(1)

The variables lnY_{PAK} , lnY_{JPN} (log of the Japan real GDP), lnAVOF, lnCHM, lnCMIEF, lnFLA, lnMTE, lnMFL , lnBT and lnMGC, are stationary at level, i.e. I (0). While$lnREX_{i,t}$, POS, NEG, lnCT, and lnMMI are non-stationary at level but are stationary at 1st difference, hence I(1).

Table 3: ADF test results of Pakistan and China industry trade

Variables	Level		1st difference		Conclusion
	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
$lnREX_{i,t}$	0.0165	0.0749	-	-	I(0)
POS	0.6273	0.8157	0.0001	0.0006	I(1)
NEG	0.0451	0.0371	-	-	I(0)
lnY_{PAK}	0.0132	0.7420	-	-	I(0)
lnY_{CHN}	0.2135	0.998	0.0992	0.1371	I(1)
lnAVOF	0.0000	0.0001			I(0)
lnBT	0.0071	0.0022			I(0)
lnCHM	0.0278	0.0804			I(0)
lnCT	0.0000	0.2331			I(0)
lnCMIEF	0.0259	0.0004			I(0)
LnFLA	0.1642	0.0163			I(0)
LnMTE	0.0001	0.0000			I(0)
LnMGC	0.5338	0.8565	0.0001	0.0004	I(1)
LnMFL	0.2725	0.5235	0.0000	0.0000	I(1)
lnMMI	0.1014	0.0454			I(0)

The variables lnY_{PAK}, $lnREX_{i,t}$, , NEG, lnAVOF, lnCHM, lnCMIEF , lnFLA , lnMTE, lnBT, lnMMI and lnCT are stationary at level, i.e. I (0). While lnY_{CHN} (log of the China real GDP), POS, lnMFL and lnMGC are non-stationary at level but are stationary at 1st difference, hence I(1).

Table 4: ADF test results of Pakistan and Germany trade

Variables	Level		1st difference		Conclusion
	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
$\mathbf{lnREX_{i,t}}$	0.4377	0.9456	0.0000	0.0009	I(1)
POS	0.1189	0.4444	0.0000	0.0002	I(1)
NEG	0.9998	0.9691	0.0004	0.0005	I(1)
$\mathbf{lnY_{PAK}}$	0.0132	0.7420	-	-	I(0)
$\mathbf{lnY_{GER}}$	0.5028	0.9295	0.0004	0.0005	I(1)
LnAvof	0.0000	0.0001			I(0)
lnBT	0.0178	0.0554			I(0)
lnCHM	0.0445	0.0016			I(0)
lnCT	0.0003	0.0011			I(0)
lnCMIEF	0.4107	0.0042			I(0)
LnFLA	0.5194	0.0444			I(0)
LnMTE	0.0235	0.0081			I(0)
LnMGC	0.0104	0.0042			I(0)
LnMFL	0.0000	0.0001			I(0)
lnMMI	0.0048	0.0153			I(0)

The variables lnY_{PAK} , lnAVOF, lnCHM, lnCMIEF, lnFLA , lnMTE , lnBT and lnMMI, lnMFL, lnMGC and lnCTare stationary at level, i.e. I (0). While $lnY_{GERMANY}$ (log of the Germany real GDP),$lnREX_{i,t}$,NEG, POS are non-stationary at level but are stationary at 1st difference, hence I(1).

Table 5: ADF test results of Pakistan and United States trade

Variables	Level		1st difference		Conclusion
	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
$\mathbf{lnREX_{i,t}}$	0.0215	0.7104	0.0000	0.0132	I(1)
POS	0.0120	0.0396	0.0000	0.0000	I(1)
NEG	0.9996	0.8394	0.0001	0.0001	I(1)
$\mathbf{lnY_{PAK}}$	0.0132	0.7420	-	-	I(0)
$\mathbf{lnY_{US}}$	0.2769	0.9751	0.0118	0.0000	I(1)
LnAvof	0.6299	0.5508	0.0001	0.0004	I(1)
lnBT	0.1574	0.0159			I(0)
LnChm	0.0000	0.0001			I(0)
LnCt	0.0037	0.0100			I(0)
lnCMIEF	0.8542	0.6761	0.0000	0.0000	I(1)
LnFLA	0.0154	0.0440			I(0)
LnMTE	0.1408	0.0753			I(0)
LnMGC	0.0735	0.2175			I(0)
LnMFL	0.0003	0.0011			I(0)
LnMMA	0.0073	0.0172			I(0)

The variables lnY_{PAK}, lnCHM, lnFLA, lnMTE, lnMFL, lnBT, lnCT, lnMMI and lnMGC are stationary at level, i.e. I (0). While $lnREX_{i,t}$, POS, NEG, lnY_{US} (log of the United states real GDP), lnAVOF and lnCMIEF are non-stationary at level but are stationary at 1st difference, hence I(1).

Table 6: ADF test results of Pakistan and United Kingdom industry trade

Variables	Level		1st difference		Conclusion
	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
$\mathbf{lnREX_{i,t}}$	0.1971	0.9911	0.0002	0.0268	I(1)
POS	0.0093	0.8422	0.0006	0.0028	I(1)
NEG	0.9985	0.7420	0.0004	0.0011	I(1)
$\mathbf{lnY_{PAK}}$	0.0132	0.7420	-	-	I(0)
$\mathbf{lnY_{UK}}$	0.1702	0.7972	0.0202	0.0246	I(1)
lnAVOF	0.0158	0.2030			I(0)
lnBT	0.0002	0.0005			I(0)
LnChm	0.5790	0.0237			I(0)
lnCT	0.0026	0.0001			I(0)
lnCMIEF	0.2941	0.0046			I(0)
LnFLA	0.0004	0.0017			I(0)
LnMTE	0.2581	0.0231			I(0)
LnMGC	0.1089	0.0299			I(0)
LnMFL	0.0000	0.0000			I(0)
LnMMI	0.0695	0.0001	-	-	I(0)

The variables lnY_{PAK}, lnCHM, lnFLA, lnMTE, lnMFL, lnBT, lnCT, lnMMI, lnAVOF, lnCmief and lnMGC are stationary at level, i.e. I (0). While$lnREX_{i,t}$, POS, NEG and lnY_{US} (log of the United states real GDP) are non-stationary at level but are stationary at 1st difference, hence I (1).

5.3 Results of Bound Testing Approach to Cointegration

As quoted by Ouattara, (2004) F test would be spurious if variables are I (2). So, after ensuring that no variable is I (2), the bounding testing approach to cointegration has been employed in this study and obtains the following results.

5.3.1 Results of Bound Testing Approach

The results of the bounds testing approach to cointegration in linear and nonlinear ARDL models are given in the following table**.** The long run results of both models are to be verified through the test of cointegration. Given the upper and lower bound value of F statistics given by Pesaran and Shin (2001), null hypothesis study H0: C1=C2=C3=C4=0 showing no Cointegration was tested against the alternative hypotheses that at least one of them is not equal to zero and represents the existence of Cointegration.

Table 7: Results of Bound test

Variable	Saudi Arabia	Japan	China	Germany	United States	United kingdom
lnAVOF	Yes	YES	Yes	Yes	Incon	Yes
lnBT	Incon	YES	Yes	Yes	Yes	Incon
lnCHM	Yes	Incon	Yes	Yes	No	Yes
lnCT	YES	YES	Yes	Yes	Yes	Yes
lnCMIEF	YES	YES	Yes	Yes	Incon	Yes
LnFLA	YES	YES	Incon	Yes	No	Yes
LnMTE	YES	YES	Yes	Yes	Yes	Yes
LnMGC	YES	YES	No	Yes	Yes	Yes
LnMFL	YES	YES	Incon	Yes	Yes	Yes
lnMMI	YES	Incon	Yes	Yes	Yes	Yes

Results of bound test for sampled Countries (Linear Model):

In case of Saudi Arabia, the results show that coefficient of 9 industries indicate that there is long run relationship among the variables. There is only 1 industry which gives inconclusive results.

The results of the bounds testing approach to Cointegration for Japan shows that The F statistics value is greater than the critical value in 8 cases, showing cointegration among 8 out of 10 industries. The F stat value of the remaining 2 industries give inconclusive results. In the case of United Kingdom, the results show cointegration among 9 out of 10 industries. The F stat value of the remaining 1 industry lies inside the lower and upper bound value and give inconclusive results. The F statistics in case of United States shows cointegration among 6 out of 10 industries. The F stat value of the remaining 2 industries lies inside the lower and upper bound value of the F table and give inconclusive results. The F statistics value of 2 industries lies below the lower bound value of the F table and shows evidence of no cointegration. For the Germany the F statistics showing cointegration among 10 out of 10 industries. The results for China shows cointegration among 7 out of 10 industries. The F stat value of the remaining 2 industries lies inside the lower and upper bound value of the F table and give inconclusive results, value of 1 industry lies below the lower bound value of the F table and shows evidence of no cointegration.

Results of bound test for sampled Countries (Nonlinear Model)

The nonlinear results in case of Saudi Arabia confirms cointegration for all industries. 9 out of 10 industries in Japan shows cointegration while 1 industry has inconclusive results. The results in case of United Kingdom shows cointegration in 9 industries while 1 industry has inconclusive results. For the United States, 6 industries confirm cointegration while 3 industries have inconclusive results while the F statistics value of 1 industry lies below the lower bound value of the F table and shows evidence of no cointegration. In case of Germany 8 industries confirms the existence of cointegration. While 1 industry has inconclusive results and the F statistics value of 1 industry lies below the lower bound value of the F table and shows evidence of no cointegration. In case of China 8 industries shows cointegration while there is only 1 industry which gives inconclusive results. The remaining 1 industry shows no cointegration.

5.4 Results of Commodity trade between Pakistan and her Major Trading Partners

The empirical results of commodity trade between Pakistan and her major trading partners are reported in the below tables. Taking a look at the sample size, we uphold a most extreme of three lags on every one of the first-differenced variable and after that let the AIC criterion to pick the ideal slack/lag structure. The short and long-run results of our study are given below.

Table 8: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for Pakistan and China Industry trade

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L - ARDL	NL – ARDL	L – ARDL	NL - ARDL	L – ARDL	NL – ARDL
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	-0.40(3.65)	-0.19(1.50)	-14.15(1.30)	-31.91(1.58)	-0.76(1.32)	0.91(1.36)	5.89(2.09)	7.90(2.44)
$\Delta \ln Y_{PAK,t-1}$			7.66(0.49)	6.59(0.35)			13.20(2.24)	14.97(3.29)
$\Delta \ln Y_{PAK,t-2}$			-47.13(2.51)	-64.77(2.03)			-7.32(2.25)	-10.27(2.74)
$\Delta \ln Y_{PAK,t-3}$			56.31(5.56)	69.16(3.42)				
$\Delta \ln Y_{i,t}$	0.01(0.38)	0.05(1.23)	27.85(3.66)	49.39(2.55)	1.87(1.78)	-2.17(1.23)	-13.56(5.45)	-15.67(4.28)
$\Delta \ln Y_{i,t-1}$			-31.73(3.96)	-23.85(1.01)		10.32(2.31)	14.78(4.88)	19.09(4.75)
$\Delta \ln Y_{i,t-2}$			-12.58(1.72)	-26.81(1.89)		-4.36(2.19)		
$\Delta \ln Y_{i,t-3}$						1.33(1.53)		
$\Delta \ln REX_{i,t}$	0.01(0.39)		-2.01(1.28)		0.17(1.59)		-1.17(1.56)	
$\Delta \ln REX_{i,t-1}$			3.82(1.67)		-0.29(1.75)		-0.99(1.94)	
$\Delta \ln REX_{i,t-2}$					0.03(0.20)		-0.96(1.23)	
$\Delta \ln REX_{i,t-3}$								
ΔPOS_t		0.06(0.92)		1.10(0.27)		0.27(0.57)		-2.64(1.86)
ΔPOS_{t-1}				14.02(1.79)		-0.25(0.50)		
ΔPOS_{t-2}				-2.76(0.53)		-0.21(0.63)		
ΔPOS_{t-3}				-4.30(1.40)		-0.54(2.06)		
ΔNEG_t		-0.02(0.75)		-3.73(0.98)		0.14(0.56)		0.60(0.42)

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L - ARDL	NL – ARDL	L – ARDL	NL - ARDL	L – ARDL	NL – ARDL
ΔNEG_{t-1}						-0.85(2.49)		-0.73(0.62)
ΔNEG_{t-2}						0.82(1.43)		-1.97(1.68)
ΔNEG_{t-3}								
Panel B: Long-Run Estimates								
lnY_{PAK}	-0.03(0.34)	-0.17(1.18)	-31.75(4.03)	-49.35(1.84)	-0.85(1.46)	0.56(1.86)	6.40(2.86)	9.27(2.76)
lnY_i	0.01(0.38)	0.04(1.30)	13.94(3.92)	20.65(1.97)	0.33(1.22)	-0.57(3.06)	-3.41(3.34)	-4.30(3.06)
$lnREX_i$	0.01(0.39)		-9.03(3.93)		0.59(2.60)		4.15(6.16)	
POS		0.05(0.96)		-9.64(3.11)		1.95(6.97)		4.38(4.15)
NEG		-0.02(0.78)		-12.85(1.87)		1.44(8.05)		5.36(4.99)
Constant	0.35(0.28)	2.97(1.59)	436.75(4.15)	662.84(1.75)	10.84(1.41)	1.93(0.57)	-76.83(2.60)	-110.74(2.41)
Panel C: Diagnostic Statistics								
F test	9.9	7.5	13.07	7.93	5.37	7.4	16.31	15.2
ECM_{t-1}	-1.09(6.68)	-1.13(11.61)	-1.67(5.41)	-1.22(2.69)	-0.89(4.15)	-1.61(3.62)	-0.99(6.06)	-0.96(8.23)
LM	0.80	0.56	0.47	0.23	0.000	0.66	0.99	0.60
RESET	0.00	2.39	5.28	2.35	10.39	2.43	3.36	0.46
Adjusted R^2	0.54	0.55	0.82	0.85	0.63	0.94	0.82	0.90
$CS(CS^2)$	S(NS)	S(NS)	S(S)	S(S)	S(NS)	S(S)	S(S)	S(S)
$WALD-S$		1.46		22.73		6.87		5.97
$WALD-L$		0.32		0.43		11.09		11.33

Table 9: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and China industry trade

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L – ARDL	NL – ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L – ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta\ln Y_{PAK,t}$	-0.37(1.49)	0.23(0.14)	0.52(0.09)	-5.59(1.13)	0.18(3.63)			
$\Delta\ln Y_{PAK,t-1}$	0.16(2.93)	-4.68(1.44)	-7.43(1.91)					
$\Delta\ln Y_{PAK,t-2}$		-0.16(0.04)	31.86(1.87)	31.08(3.78)	0.02(0.23)		14.90(1.12)	14.78(1.37)
$\Delta\ln Y_{PAK,t-3}$		-2.23(0.86)	-23.44(3.11)	-20.82(5.08)	0.16(1.65)		-11.42(1.64)	-10.80(2.16)
$\Delta\ln Y_{i,t}$					-0.12(1.71)			
$\Delta\ln Y_{i,t-1}$								
$\Delta\ln Y_{i,t-2}$	-0.03(0.06)	1.89(1.69)	-14.83(3.95)	-7.32(2.04)	0.04(0.76)	0.09(2.11)	4.46(1.96)	6.86(1.86)
$\Delta\ln Y_{i,t-3}$		-1.65(0.41)	3.49(0.44)	-14.95(1.36)	0.09(1.09)	0.16(1.34)		-13.51(2.11)
$\Delta\ln REX_{i,t}$		-1.24(0.31)	2.11(0.27)	3.01(0.20)	-0.18(2.94)	-0.30(2.27)		-1.43(0.24)
$\Delta\ln REX_{i,t-1}$		3.97(1.64)	-9.54(1.65)	-8.53(0.91)		0.08(1.20)		5.73(1.75)
$\Delta\ln REX_{i,t-2}$								
$\Delta\ln REX_{i,t-3}$	-0.17(1.68)		1.22(0.62)					
ΔPOS_{t}	-0.004(0.39)		-0.28(0.39)					
ΔPOS_{t-1}			0.04(0.02)				1.82(1.90)	
ΔPOS_{t-2}			-0.09(0.58)					
ΔPOS_{t-3}			4.86(3.33)					
ΔNEG_{t}		-0.69(0.73)		3.00(0.86)		-0.01(0.43)		

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L – ARDL	NL – ARDL	L - ARDL	NL - ARDL	L - ARDL	NL - ARDL	L – ARDL	NL - ARDL
ΔNEG_{t-1}	0.69(0.85)							
ΔNEG_{t-2}		-0.61(0.92)		-4.27(1.31)				
ΔNEG_{t-3}		1.52(2.20)		-1.01(0.24)				
Panel B: Long-Run Estimates								
$\ln Y_{PAK}$	7.41(2.22)	17.85(5.59)	-2.05(1.89)	-3.47(1.77)	0.23(1.91)	0.24(2.46)	-6.63(1.39)	0.16(0.17)
$\ln Y_i$	-3.68(2.50)	-7.42(5.20)	1.18(2.30)	1.73(2.63)	0.10(1.92)	-0.09(2.05)	2.80(1.34)	-1.19(3.23)
$\ln REX_i$	0.25(0.18)		-0.28(0.71)		0.04(1.22)		-1.01(0.57)	
POS		0.98(0.96)		-0.39(0.67)		-0.02(0.73)		3.40(16.50)
NEG		3.97(5.24)		-0.68(0.88)		0.03(1.30)		1.04(6.10)
Constant	-83.49(1.88)	-236.83(5.76)	19.86(1.49)	38.96(1.20)	2.95(1.86)	-3.57(2.73)	92.53(1.38)	28.93(2.11)
Panel C: Diagnostic Statistics								
F test	8	8.41	4.28	3.13	354.24	12.4	1.46	10.35
ECM_{t-1}	-0.77(5.28)	-1.81(4.23)	-0.68(4.92)	-0.68(4.88)	-1.05(28.12)	-1.41(7.73)	-0.17(2.26)	-1.11(7.88)
LM	0.92	1.19	5.3	10.09	1.47	2.07	0.64	0.13
RESET	0.24	0.0009	0.32	0.49	1.48	0.56	0.25	9.95
Adjusted R^2	0.85	0.93	0.57	0.58	0.98	0.84	0.26	0.83
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)	S(NS)	S(S)	S(S)	S(S)
$WALD - S$		11.80		0.87		1.02		11.78
$WALD - L$		21.90		1.09		2.09		10.87

Table 10: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and China industry trade

	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL - ARDL				
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	4.60(1.13)	-4.04(0.75)	0.46(2.81)	0.28(2.33)				
$\Delta \ln Y_{PAK,t-1}$		6.67(0.67)		0.35(1.44)				
$\Delta \ln Y_{PAK,t-2}$		7.60(0.92)		0.31(1.69)				
$\Delta \ln Y_{PAK,t-3}$		-18.11(2.50)		-0.48(3.73)				
$\Delta \ln Y_{i,t}$	-2.28(1.23)	8.57(1.34)	-0.71(3.80)	-0.59(3.74)				
$\Delta \ln Y_{i,t-1}$		-36.91(2.07)	0.44(2.62)	0.55(2.29)				
$\Delta \ln Y_{i,t-2}$		52.47(3.26)	-0.31(3.37)	-0.46(3.24)				
$\Delta \ln Y_{i,t-3}$		-29.15(3.99)						
$\Delta \ln REX_{i,t}$	1.98(1.61)		0.06(1.61)					
$\Delta \ln REX_{i,t-1}$	-2.65(1.48)		-0.002(0.14)					
$\Delta \ln REX_{i,t-2}$	2.40(3.09)		0.03(1.99)					
$\Delta \ln REX_{i,t-3}$			-0.05(4.77)					
ΔPOS_{t}		5.01(1.96)		-0.04(0.70)				
ΔPOS_{t-1}		-8.94(3.72)		0.15(2.06)				
ΔPOS_{t-2}		7.28(2.56)						
ΔPOS_{t-3}		4.21(2.02)						
ΔNEG_{t}		-2.21(1.60)		0.10(2.16)				

	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	**NL – ARDL**	**L - ARDL**	**NL - ARDL**				
ΔNEG_{t-1}				-0.12(2.51)				
ΔNEG_{t-2}				0.11(4.58)				
ΔNEG_{t-3}								
Panel B: Long-Run Estimates								
lnY_{PAK}	6.70(1.20)	3.88(0.90)	0.07(0.60)	0.05(0.42)				
lnY_i	-3.31(1.31)	-0.79(0.44)	-0.02(0.45)	0.04(0.84)				
$lnREX_i$	0.36(0.29)		0.06(1.51)					
POS		-3.79(5.19)		-0.15(2.52)				
NEG		-1.43(1.70)		0.006(0.17)				
Constant	-74.88(1.04)	-73.37(1.25)	-1.20(0.75	-2.38(1.50)				
Panel C: Diagnostic Statistics								
F test	14.12	18.64	9.42	11.4				
ECM_{t-1}	-0.68(3.71)	-1.54(1.37)	-1.02(6.22)	-1.24(9.29)				
LM	0.76	0.12	0.36	0.17				
RESET	2.55	2.87	1.98	6.13				
Adjusted R^2	0.71	0.88	0.78	0.91				
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)				
$WALD - S$		10.33		17.21				
$WALD - L$		0.56		8.70				

Table 11: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for Pakistan and Japan industry trade

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L – ARDL	NL - ARDL	L - ARDL	NL - ARDL	L – ARDL	NL – ARDL
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	0.09(1.24)	-0.04(0.25)	1.38(0.99)	-4.89(0.78)	0.08(0.67)	-0.45(2.10)	0.22(0.48)	2.47(1.04)
$\Delta \ln Y_{PAK,t-1}$				24.70(1.70)				3.36(1.65)
$\Delta \ln Y_{PAK,t-2}$				-11.43(0.73)				
$\Delta \ln Y_{PAK,t-3}$				13.02(1.44)				
$\Delta \ln Y_{i,t}$	-0.28(1.08)	-0.20(1.21)	-5.37(1.15)	-13.08(1.22)	-0.08(0.19)	0.55(3.26)	-1.14(0.60)	-8.42(2.62)
$\Delta \ln Y_{i,t-1}$				-15.39(1.69)	0.33(0.98)	0.14(0.53)	5.74(2.14)	0.28(0.13)
$\Delta \ln Y_{i,t-2}$					0.93(2.49)	0.91(3.06)	-3.92(2.26)	-6.87(3.76)
$\Delta \ln Y_{i,t-3}$					-0.75(2.23)	-0.83(3.36)		3.36(1.80)
$\Delta \ln REX_{i,t}$	0.09(0.69)		3.08(0.99)		0.22(1.92)		-0.49(0.68)	
$\Delta \ln REX_{i,t-1}$			-9.24(1.78)		-0.44(2.23)		-1.31(1.91)	
$\Delta \ln REX_{i,t-2}$					0.28(1.82)		1.28(1.49)	
$\Delta \ln REX_{i,t-3}$							-2.00(1.96)	
ΔPOS_{t}		0.18(0.70)		4.08(0.82)		0.40(2.54)		-3.05(2.09)
ΔPOS_{t-1}				-2.60(0.57)				-3.29(3.30)
ΔPOS_{t-2}				-12.41(1.52)				-2.56(2.98)
ΔPOS_{t-3}								
ΔNEG_{t}		-0.01(0.11)		8.15(1.90)		-0.35(1.73)		-1.03(0.82)

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L – ARDL	NL - ARDL	L - ARDL	NL - ARDL	L – ARDL	NL – ARDL
ΔNEG_{t-1}				-15.13(2.69)				-1.49(0.58)
ΔNEG_{t-2}								7.08(2.61)
ΔNEG_{t-3}								-7.33(3.20)
Panel B: Long-Run Estimates								
lnY_{PAK}	0.09(1.33)	-0.03(0.26)	1.63(0.96)	-19.78(2.56)	0.14(0.76)	-0.57(2.14)	0.24(0.48)	0.62(0.55)
lnY_i	-0.26(1.16)	-0.18(1.31)	-6.33(1.11)	-1.33(0.35)	-0.17(0.30)	0.30(1.02)	-2.68(2.00)	-5.70(2.11)
$lnREX_i$	0.08(0.72)		5.45(1.35)		0.15(0.66)		0.74(0.77)	
POS		0.16(0.74)		26.25(2.76)		0.50(2.65)		1.80(1.19)
NEG		-0.01(0.11)		-7.78(1.64)		-0.44(1.78)		1.59(0.98)
Constant	5.24(1.10)	5.99(1.05)	141.00(1.15)	525.42(2.58)	1.16(0.10)	5.62(1.14)	72.08(2.71)	150.56(2.47)
Panel C: Diagnostic Statistics								
F test	9.09	4.68	7.24	7.42	3.58	3.87	6.73	6.42
ECM_{t-1}	-1.09(10.90)	-1.11(9.78)	-0.85(12.21)	-1.05(5.45)	-0.55(4.12)	-0.79(6.64)	-0.92(9.32)	-1.05(5.26)
LM	0.93	0.90	0.95	0.53	0.49	0.75	0.73	0.07
RESET	0.34	1.74	17.20	6.98	3.89	6.09	4.74	6.07
Adjusted R^2	0.54	0.55	0.51	0.72	0.54	0.60	0.51	0.67
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)	S(S)	S(S)	S(S)	S(S)
$WALD-S$		1.09		3.53		12.98		7.77
$WALD-L$		1.87		11.23		10.09		4.09

Table 12: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and Japan industry trade

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L – ARDL	NL – ARDL	L – ARDL	NL – ARDL	L - ARDL	NL - ARDL	L – ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta \mathbf{lnY_{PAK,t}}$	0.15(1.93)	-0.68(0.30)	-15.92(2.75)	-15.56(2.74)	0.00(1.10)	0.002(0.52)	-3.13(1.71)	-3.52(2.42)
$\Delta \mathbf{lnY_{PAK,t-1}}$	8.75(1.35)	9.88(1.46)	30.18(1.94)	30.58(1.83)			16.27(1.74)	17.96(1.95)
$\Delta \mathbf{lnY_{PAK,t-2}}$	-8.79(2.16)	-10.49(2.54)	-16.41(1.56)	-16.82(1.43)			-11.01(2.02)	-4.50(0.57)
$\Delta \mathbf{lnY_{PAK,t-3}}$								-12.35(2.45)
$\Delta \mathbf{lnY_{i,t}}$	7.79(4.29)	8.24(2.96)	6.61(3.11)	6.17(3.31)	0.00(0.84)	-0.010(1.54)	4.20(3.42)	-1.93(0.26)
$\Delta \mathbf{lnY_{i,t-1}}$	-0.68(0.31)	0.63(0.31)				-0.002(0.65)		-7.28(1.27)
$\Delta \mathbf{lnY_{i,t-2}}$	5.30(2.07)	5.91(2.56)				-0.015(2.41)		3.61(1.37)
$\Delta \mathbf{lnY_{i,t-3}}$								6.43(1.60)
$\Delta \mathbf{lnREX_{i,t}}$	0.73(1.32)		-1.18(0.92)		0.00(0.72)		-0.45(0.70)	
$\Delta \mathbf{lnREX_{i,t-1}}$	1.21(0.98)							
$\Delta \mathbf{lnREX_{i,t-2}}$	-0.30(0.30)							
$\Delta \mathbf{lnREX_{i,t-3}}$	1.89(2.53)							
$\Delta \mathbf{POS_{t}}$		0.86(0.71)		-1.67(0.51)		-0.005(1.53)		-3.12(1.29)
$\Delta \mathbf{POS_{t-1}}$		1.62(0.99)				-0.001(0.44)		-2.20(0.72)
$\Delta \mathbf{POS_{t-2}}$		0.35(0.36)				-0.007(3.05)		0.27(0.17)
$\Delta \mathbf{POS_{t-3}}$		2.60(3.28)						4.89(2.88)

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L – ARDL	NL – ARDL	L – ARDL	NL – ARDL	L - ARDL	NL - ARDL	L – ARDL	NL - ARDL
ΔNEG_t		-0.17(0.11)		-0.67(0.35)		-0.009(1.91)		-2.34(0.85)
ΔNEG_{t-1}		0.86(0.71)				-0.002(0.78)		3.11(1.32)
ΔNEG_{t-2}		1.62(0.99)				0.011(2.61)		1.11(0.44)
ΔNEG_{t-3}						-0.012(2.80)		-8.36(1.54)
Panel B: Long-Run Estimates								
$\ln Y_{PAK}$	-1.32(2.12)	-0.62(0.36)	-3.97(3.37)	-3.07(0.84)	0.00(1.16)	0.001(0.53)	-2.56(5.50)	2.95(1.39)
$\ln Y_i$	4.72(2.54)	4.40(3.26)	8.79(2.90)	8.29(3.36)	0.00(0.87)	-0.007(2.84)	4.77(3.95)	1.05(0.28)
$\ln REX_i$	-2.58(2.49)		-1.57(0.90)		0.00(0.76)		-0.50(0.71)	
POS		-3.16(2.08)		-2.24(0.50)		-0.002(0.90)		-4.42(3.80)
NEG		-1.83(1.52)		-0.90(0.36)		0.0009(0.44)		3.71(1.59)
Constant	-101.94(2.67)	-111.02(3.76)	-152.56(2.62)	-160.75(1.81)	-0.02(0.67)	0.170(2.57)	-72.66(3.09)	-101.34(1.54)
Panel C: Diagnostic Statistics								
F test	7.92	7.13	6.33	4.93	7.99	17.63	8.51	6.94
ECM_{t-1}	-0.96(6.44)	-1.05(6.45)	-0.75(6.56)	-0.74(6.01)	-0.97(8.61)	-1.25(6.13)	-0.88(9.67)	-1.37(6.98)
LM	1.45	3.73	0.82	0.96	10.56	9.02	0.98	0.83
RESET	0.95	0.34	0.81	0.95	0.68	0.25	0.79	0.20
Adjusted R^2	0.63	0.69	0.59	0.59	0.49	0.80	0.65	0.80
$CS(CS^2)$	NS(S)	S(S)	S(S)	S(S)	NS(NS)	S(S)	S(S)	S(S)
$WALD-S$		2.33		0.09		5.11		2.32
$WALD-L$		11.34		1.22		4.98		0.95

Table 13: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and Japan industry trade

3.8	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL - ARDL				
	Panel A: Short–Run Estimates							
$\Delta \ln Y_{PAK,t}$	-4.26(1.26)	-0.89(0.24)	-2.51(3.83)	-3.06(3.78)				
$\Delta \ln Y_{PAK,t-1}$	-1.48(0.27)	-13.63(1.14)	4.17(1.05)	8.76(2.06)				
$\Delta \ln Y_{PAK,t-2}$	5.72(0.61)	14.70(1.48)	-3.93(1.54)	-4.87(1.97)				
$\Delta \ln Y_{PAK,t-3}$	-11.01(1.83)	-13.16(2.02)						
$\Delta \ln Y_{i,t}$	6.30(1.63)	6.21(0.79)	3.06(3.47)	-0.41(0.25)				
$\Delta \ln Y_{i,t-1}$	12.28(2.23)	21.52(3.45)						
$\Delta \ln Y_{i,t-2}$	-13.49(2.57)	-9.17(1.25)						
$\Delta \ln Y_{i,t-3}$	11.36(3.56)	8.38(2.08)						
$\Delta \ln REX_{i,t}$	2.45(2.33)		-0.60(1.10)					
$\Delta \ln REX_{i,t-1}$			0.43(0.59)					
$\Delta \ln REX_{i,t-2}$			0.56(1.11)					
$\Delta \ln REX_{i,t-3}$								
ΔPOS_{t}		4.16(1.54)		-1.19(1.75)				
ΔPOS_{t-1}		-4.78(1.07)						
ΔPOS_{t-2}		8.51(1.83)						
ΔPOS_{t-3}		-8.01(1.95)						
ΔNEG_{t}		12.89(4.76)		1.71(0.85)				

3.8	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL - ARDL				
ΔNEG_{t-1}		-0.74(0.23)						
ΔNEG_{t-2}		-8.01(2.20)						
ΔNEG_{t-3}		15.43(2.79)						
Panel B: Long-Run Estimates								
$\ln Y_{PAK}$	2.28(4.02)	0.83(0.20)	-1.55(3.06)	-3.12(2.92)				
$\ln Y_i$	-4.63(2.91)	-3.50(0.76)	5.68(3.19)	4.19(5.29)				
$\ln REX_i$	2.17(2.29)		-3.16(3.42)					
POS		5.05(0.85)		0.27(0.31)				
NEG		0.97(0.30)		-3.00(3.56)				
Constant	76.85(2.30)	80.30(0.50)	-123.71(3.17)	-43.32(2.91)				
Panel C: Diagnostic Statistics								
F test	10.53	15.02	4.22	4.68				
ECM_{t-1}	-1.13(7.65)	-1.17(7.33)	-0.54(3.36)	-0.71(4.98)				
LM	1.34	2.45	1.31	3.89				
RESET	0.24	0.89	0.13	0.03				
Adjusted R^2	0.74	0.86	0.34	0.49				
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)				
$WALD-S$		1.78		12.34				
$WALD-L$		2.01		3.22				

Table 14: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for Pakistan and United States industry trade

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L – ARDL	NL - ARDL	L - ARDL	NL - ARDL	L – ARDL	NL – ARDL
Panel A: Short–Run Estimates								
$\Delta \mathbf{lnY_{PAK,t}}$	-0.31(1.97)	-0.31(2.62)	7.40(0.94)	6.54(1.69)	0.57(1.05)	1.94(2.31)	-0.73(1.12)	9.66(4.75)
$\Delta \mathbf{lnY_{PAK,t-1}}$			0.12(0.000)	-3.27(0.25)	-1.02(1.34)	-3.22(3.06)	4.50(2.27)	2.35(0.54)
$\Delta \mathbf{lnY_{PAK,t-2}}$			23.26(1.39)	11.08(1.47)		1.15(1.34)	-2.64(2.76)	6.59(1.31)
$\Delta \mathbf{lnY_{PAK,t-3}}$			-17.50(2.60)			0.85(1.64)	-17.50(2.60)	-9.48(2.25)
$\Delta \mathbf{lnY_{i,t}}$	0.03(0.62)	-0.19(1.30)	-2.02(0.61)	1.84(0.51)	0.14(0.64)	0.14(0.19)	0.02(0.08)	-6.17(1.46)
$\Delta \mathbf{lnY_{i,t-1}}$		-0.30(2.13)		-1.05(0.13)				-4.00(1.13)
$\Delta \mathbf{lnY_{i,t-2}}$		0.48(1.93)		-2.95(0.35)				10.56(2.70)
$\Delta \mathbf{lnY_{i,t-3}}$		-0.13(1.48)		8.24(1.31)				-10.99(4.77)
$\Delta \mathbf{lnREX_{i,t}}$	-0.06(1.57)		1.58(0.49)		0.21(1.14)		0.10(0.31)	
$\Delta \mathbf{lnREX_{i,t-1}}$	0.05(1.50)		-0.22(0.08)				0.72(2.48)	
$\Delta \mathbf{lnREX_{i,t-2}}$	-0.03(1.21)		6.31(2.96)				-0.58(2.57)	
$\Delta \mathbf{lnREX_{i,t-3}}$								
$\Delta \mathbf{POS_{t}}$		-0.04(0.86)		5.67(2.08)		1.34(2.61)		-3.11(2.66)
$\Delta \mathbf{POS_{t-1}}$		0.01(0.33)		1.41(0.35)		-0.38(0.95)		
$\Delta \mathbf{POS_{t-2}}$		-0.19(3.01)		2.49(1.47)		0.12(0.51)		
$\Delta \mathbf{POS_{t-3}}$						-0.28(1.67)		
$\Delta \mathbf{NEG_{t}}$		-0.05(0.88)		8.75(2.79)		1.01(4.11)		5.09(4.15)

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L – ARDL	NL - ARDL	L - ARDL	NL - ARDL	L – ARDL	NL – ARDL
ΔNEG_{t-1}		0.01(0.13)		-3.87(0.97)		-0.15(0.30)		-4.82(2.16)
ΔNEG_{t-2}		0.04(0.72)		7.32(2.53)		1.30(1.94)		10.24(5.70)
ΔNEG_{t-3}		0.09(1.66)						-4.72(3.51)
Panel B: Long-Run Estimates								
$\ln Y_{PAK}$	-0.02(0.33)	0.04(0.47)	3.70(1.41)	2.30(1.18)	0.19(1.47)	-0.38(1.10)	-0.25(1.13)	1.05(1.09)
$\ln Y_i$	0.06(0.52)	-0.34(2.13)	-2.17(0.57)	-17.02(2.97)	0.14(0.64)	-0.71(1.49)	0.02(0.08)	3.55(4.48)
$\ln REX_i$	-0.06(1.47)		-0.47(0.47)		-0.39(5.03)		-0.02(0.12)	
POS		0.20(2.67)		13.52(3.47)		0.90(5.34)		-3.24(3.19)
NEG		-0.07(1.40)		-3.90(3.48)		-0.63(2.69)		2.51(2.80)
Constant	-0.94(0.58)	9.07(2.78)	-26.38(0.56)	439.39(3.07)	-7.58(2.34)	30.74(7.21)	5.88(1.53)	-129.33(4.01)
Panel C: Diagnostic Statistics								
F test	2.47	1.53	7.23	11.84	2.95	3.11	15.5	12.19
ECM_{t-1}	-0.61(2.21)	-0.64(3.50)	-0.93(5.72)	-1.04(4.87)	-0.97(3.07)	-0.50(4.36)	-0.93(5.72)	-1.43(8.39)
LM	0.63	0.58	0.49	0.08	0.80	0.74	0.13	0.06
RESET	5.77	3.35	0.01	0.03	4.74	3.62	0.13	0.11
Adjusted R^2	0.48	0.69	0.62	0.78	0.47	0.74	0.81	0.87
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)	S(S)	S(NS)	S(S)	S(S)
$WALD - S$		11.06		20.09		7.73		5.52
$WALD - L$		10.73		13.12		17.90		7.22

Table 15: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and United States

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L – ARDL	NL – ARDL	L – ARDL	NL – ARDL	L - ARDL	NL - ARDL	L – ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	-0.73(1.11)	-0.43(0.95)	3.59(2.90)	3.07(2.09)	-0.04(4.06)	0.03(3.80)	2.42(0.66)	-5.33(1.10)
$\Delta \ln Y_{PAK,t-1}$	4.50(2.27)	4.10(1.95)	5.84(1.53)				24.54(1.50)	25.51(2.59)
$\Delta \ln Y_{PAK,t-2}$	-2.63(2.75)	-1.06(0.84)	3.17(0.79)				-13.26(1.86)	-1.06(0.16)
$\Delta \ln Y_{PAK,t-3}$		-1.70(2.38)	-6.29(2.82)					-6.53(1.37)
$\Delta \ln Y_{i,t}$	0.02(0.07)	0.77(2.69)	-2.12(1.81)	-2.87(1.46)	0.04(1.45)	0.02(1.77)	1.54(0.39)	11.74(1.82)
$\Delta \ln Y_{i,t-1}$			3.74(1.34)	4.57(1.31)	-0.05(0.92)		16.85(2.15)	6.02(0.63)
$\Delta \ln Y_{i,t-2}$			-5.12(3.46)	-6.26(2.06)	0.03(0.50)		-17.74(2.22)	-15.90(1.74)
$\Delta \ln Y_{i,t-3}$				2.37(1.34)	-0.07(1.24)		11.59(3.19)	
$\Delta \ln REX_{i,t}$	0.10(0.30)		-0.69(0.88)		0.002(0.42)		-0.54(0.43)	
$\Delta \ln REX_{i,t-1}$	0.71(2.47)		-0.20(0.26)				-0.46(0.32)	
$\Delta \ln REX_{i,t-2}$	-0.57(2.56)		1.82(3.93)				-0.41(0.34)	
$\Delta \ln REX_{i,t-3}$							2.33(1.87)	
ΔPOS_t		0.68(1.63)		1.56(1.81)		0.01(2.81)		-5.13(1.85)
ΔPOS_{t-1}		-0.86(2.49)		0.97(0.74)				-2.59(1.21)
ΔPOS_{t-2}				-0.79(0.80)				3.23(1.12)
ΔPOS_{t-3}				-1.22(1.48)				2.06(1.46)
ΔNEG_t		0.47(3.47)		-1.00(0.73)		-0.02(3.41)		9.39(3.55)

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L – ARDL	NL – ARDL	L – ARDL	NL – ARDL	L - ARDL	NL - ARDL	L – ARDL	NL - ARDL
ΔNEG_{t-1}				-0.77(0.77)		0.005(0.20)		6.19(1.57)
ΔNEG_{t-2}				2.74(2.58)		-0.04(1.35)		-6.47(1.86)
ΔNEG_{t-3}								11.01(3.37)
Panel B: Long-Run Estimates								
$\ln Y_{PAK}$	-0.24(1.13)	0.37(1.69)	-3.17(4.54)	-4.02(5.69)	-0.06(4.68)	-0.05(2.90)	-3.64(1.80)	-6.54(4.37)
$\ln Y_i$	0.02(0.07)	0.67(1.84)	5.89(5.74)	1.01(0.60)	0.11(5.11)	0.03(1.57)	7.98(2.42)	15.73(4.75)
$\ln REX_i$	-0.016(0.12)		-1.58(5.82)		-0.02(3.18)		0.39(0.46)	
POS		-1.12(2.29)		3.15(3.11)		0.02(2.75)		-2.90(0.95)
NEG		0.41(2.86)		-2.84(8.04)		-0.02(3.05)		-0.20(0.19)
Constant	5.88(1.52)	-28.39(2.03)	-88.57(7.03)	69.26(1.80)	-1.73(5.15)	0.29(0.77)	-147.59(3.29)	-300.95(2.88)
Panel C: Diagnostic Statistics								
F test	9.57	10.08	12.57	10.00	5.86	3.32	7.51	10.68
ECM_{t-1}	-0.92(2.83)	-1.15(4.01)	-1.03(2.78)	-1.09(7.82)	0.66(5.28)	0.62(4.37)	-0.97(7.11)	-1.45(7.43)
LM	0.19	0.38	0.69	0.04	0.07	0.60	0.51	0.09
RESET	0.41	0.44	0.002	4.84	0.03	0.02	2.12	6.49
Adjusted R^2	0.71	0.77	0.75	0.87	0.47	0.49	0.73	0.84
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)	S(NS)	S(S)	S(S)	S(S)
$WALD-S$		11.34		9.77		8.11		21.91
$WALD-L$		9.11		2.09		19.27		2.91

Table 16: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and United States industry trade

	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL - ARDL				
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	-0.01(0.50)	-0.05(1.68)	-7.20(1.80)	-9.49(1.94)				
$\Delta \ln Y_{PAK,t-1}$		0.16(2.11)	34.71(1.35)	44.17(2.54)				
$\Delta \ln Y_{PAK,t-2}$			-20.85(1.55)	-7.83(0.62)				
$\Delta \ln Y_{PAK,t-3}$				-21.42(3.03)				
$\Delta \ln Y_{i,t}$	0.02(0.67)	-0.07(2.36)	-4.79(0.56)	0.27(0.05)				
$\Delta \ln Y_{i,t-1}$				-1.64(0.14)				
$\Delta \ln Y_{i,t-2}$				-12.64(1.31)				
$\Delta \ln Y_{i,t-3}$								
$\Delta \ln REX_{i,t}$	0.000(0.01)		1.93(1.90)					
$\Delta \ln REX_{i,t-1}$	-0.05(3.62)							
$\Delta \ln REX_{i,t-2}$	-0.001(0.09)							
$\Delta \ln REX_{i,t-3}$	0.03(2.49)							
ΔPOS_{t}		0.001(0.05)		-14.94(3.71)				
ΔPOS_{t-1}		-0.05(1.95)		-2.59(0.66)				
ΔPOS_{t-2}				5.96(1.69)				
ΔPOS_{t-3}				4.74(2.11)				
ΔNEG_{t}		0.05(1.47)		13.89(4.69)				

	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL - ARDL				
ΔNEG_{t-1}		-0.01(0.23)						
ΔNEG_{t-2}		-0.13(2.25)						
ΔNEG_{t-3}		0.12(4.97)						
Panel B: Long-Run Estimates								
lnY_{PAK}	-0.01(0.55)	-0.05(4.46)	-3.70(1.83)	-0.62(0.43)				
lnY_i	0.026(0.77)	-0.05(2.22)	5.21(1.59)	23.16(3.58)				
$lnREX_i$	0.01(2.00)		1.82(1.94)					
POS		0.11(4.95)		-15.59(3.04)				
NEG		-0.02(2.44)		6.52(6.16)				
Constant	-0.53(1.23)	2.90(3.74)	-66.96(1.54)	-660.55(3.59)				
Panel C: Diagnostic Statistics								
F test	9.62	15.08	11.03	9.87				
ECM_{t-1}	-1.11(3.73)	-1.46(4.86)	-1.06(14.91)	-1.30(11.22)				
LM	0.22	0.23	0.45	0.10				
RESET	3.70	3.63	8.01	1.79				
Adjusted R^2	0.58	0.80	0.68	0.86				
$CS(CS^2)$	NS(NS)	S(S)	S(S)	S(S)				
$WALD - S$		4.98		21.33				
$WALD - L$		11.09		3.32				

Table 17: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for Pakistan and Saudi Arabia industry trade

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L – ARDL	NL - ARDL	L - ARDL	NL - ARDL	L – ARDL	NL – ARDL
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	1.69(0.85)	-2.16(0.98)	17.32(2.09)	9.99(0.57)	-0.06(1.07)	0.24(2.78)	7.02(0.95)	5.80(0.33)
$\Delta \ln Y_{PAK,t-1}$		2.92(0.52)		44.46(1.89)			38.52(1.27)	42.99(1.18)
$\Delta \ln Y_{PAK,t-2}$		-7.62(1.13)		-44.11(2.34)			-60.50(3.39)	-70.40(3.46)
$\Delta \ln Y_{PAK,t-3}$		15.48(2.28)		39.18(2.98)			44.56(3.02)	55.28(8.03)
$\Delta \ln Y_{i,t}$	4.35(2.16)	4.31(2.44)	-2.36(0.67)	1.93(0.51)	0.10(1.30)	-0.02(1.03)	7.18(1.75)	11.58(2.49)
$\Delta \ln Y_{i,t-1}$	-2.23(1.79)		11.26(5.15)	5.70(1.90)			9.31(2.78)	6.75(1.47)
$\Delta \ln Y_{i,t-2}$	-1.28(1.27)		8.66(2.76)	7.14(1.08)			1.95(0.54)	
$\Delta \ln Y_{i,t-3}$			-8.58(2.88)				-4.10(2.07)	
$\Delta \ln REX_{i,t}$	0.80(0.80)		1.34(0.45)		0.09(0.97)		9.60(2.08)	
$\Delta \ln REX_{i,t-1}$	-1.09(0.71)		2.44(1.51)				1.64(0.22)	
$\Delta \ln REX_{i,t-2}$	2.75(2.06)		8.72(2.47)				4.65(0.71)	
$\Delta \ln REX_{i,t-3}$	-2.27(2.12)						5.91(1.48)	
ΔPOS_{t}		7.23(2.12)		5.53(0.76)		-0.07(2.11)		11.79(3.76)
ΔPOS_{t-1}		-3.38(2.34)		-4.86(0.93)				-17.31(2.22)
ΔPOS_{t-2}				-8.21(1.59)				10.75(1.62)
ΔPOS_{t-3}				6.84(2.37)				11.13(1.41)
ΔNEG_{t}		-1.27(0.54)		-0.43(0.05)		0.06(0.71)		11.32(0.97)

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L – ARDL	NL - ARDL	L - ARDL	NL - ARDL	L – ARDL	NL – ARDL
ΔNEG_{t-1}				6.32(1.29)		0.02(0.22)		34.57(11.54)
ΔNEG_{t-2}				12.94(1.31)		0.05(0.57)		-11.62(1.36)
ΔNEG_{t-3}				9.97(1.00)		0.09(1.57)		
Panel B: Long-Run Estimates								
lnY_{PAK}	-3.33(1.84)	-12.77(4.15)	1.26(0.16)	-37.38(2.93)	-0.11(0.99)	0.06(1.04)	3.44(1.42)	-3.71(0.93)
lnY_i	4.68(1.81)	4.69(3.08)	-1.89(0.24)	2.24(0.56)	0.20(1.18)	-0.03(1.04)	-2.65(0.83)	-2.20(1.63)
$lnREX_i$	3.24(0.93)		-15.98(2.15)		0.17(0.90)		8.07(0.90)	
POS		15.28(4.76)		22.96(2.05)		-0.10(2.12)		18.97(2.49)
NEG		-1.39(0.57)		-36.48(3.92)		-0.04(0.51)		7.36(1.17)
Constant	-50.53(1.42)	189.11(3.57)	68.34(1.77)	857.41(3.30)	-3.15(1.31)	-0.86(0.52)	-43.99(0.71)	143.75(1.70)
Panel C: Diagnostic Statistics								
F test	8.46	16.34	3.53	3.82	18.64	24.39	9.75	6.42
ECM_{t-1}	-0.53(3.39)	-0.91(8.62)	-0.28(3.87)	-0.64(2.66)	-0.52(10.42)	-0.75(55.75)	-0.88(5.24)	-0.94(3.58)
LM	0.10	0.08	0.01	0.04	0.08	0.01	0.25	0.62
RESET	62.33(0.00)	25.46(0.00)	9.19(0.006)	2.97(0.11)	24.5(0.00)	7.41(0.01)	0.09(0.76)	0.06(0.79)
Adjusted R^2	0.91	0.89	0.61	0.73	0.99	0.99	0.68	0.81
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)	S(NS)	S(S)	S(S)	S(S)
$WALD-S$		11.62		3.11		5.00		11.09
$WALD-L$		13.01		10.98		0.92		17.92

Table 18: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and Saudi Arabia industry trade

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L – ARDL	NL – ARDL	L – ARDL	NL – ARDL	L – ARDL	NL - ARDL	L – ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	2.43(2.11)	2.12(2.16)	1.20(0.32)	6.22(1.23)	-9.53(4.27)	1.36(0.44)	0.91(0.16)	-2.57(0.27)
$\Delta \ln Y_{PAK,t-1}$		1.85(1.21)					42.97(4.93)	53.96(2.47)
$\Delta \ln Y_{PAK,t-2}$							-6.89(0.82)	-26.41(1.17)
$\Delta \ln Y_{PAK,t-3}$							13.82(2.00)	26.80(2.42)
$\Delta \ln Y_{i,t}$	-0.05(0.14)	-0.31(0.74)	5.10(1.53)	2.82(0.42)	1.62(1.52)	0.90(0.57)	2.74(1.39)	3.25(0.81)
$\Delta \ln Y_{i,t-1}$	0.81(1.57)	0.38(0.94)			2.71(2.64)	0.48(0.42)	-0.56(1.32)	0.42(0.11)
$\Delta \ln Y_{i,t-2}$	0.50(1.85)	0.87(2.02)					5.53(2.34)	5.84(1.70)
$\Delta \ln Y_{i,t-3}$	-0.73(2.78)	-0.65(2.18)					-6.10(4.23)	-3.75(1.60)
$\Delta \ln REX_{i,t}$	0.98(2.49)		9.99(2.25)		4.12(2.38)		5.74(2.70)	
$\Delta \ln REX_{i,t-1}$	-0.41(1.10)		1.34(0.32)				6.26(2.89)	
$\Delta \ln REX_{i,t-2}$	0.97(2.37)		7.74(2.22)				8.52(3.93)	
$\Delta \ln REX_{i,t-3}$							9.57(3.72)	
ΔPOS_{t}		0.92(1.20)		1.81(0.54)		2.45(0.75)		4.35(0.65)
ΔPOS_{t-1}								-2.79(0.50)
ΔPOS_{t-2}								-7.85(1.57)
ΔPOS_{t-3}								8.56(2.95)
ΔNEG_{t}		1.01(1.46)		23.73(2.24)		3.79(1.39)		10.33(1.47)

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L – ARDL	NL – ARDL	L – ARDL	NL – ARDL	L – ARDL	NL - ARDL	L – ARDL	NL - ARDL
ΔNEG_{t-1}		-0.99(1.16)		-19.46(1.46)				0.75(0.12)
ΔNEG_{t-2}		1.49(2.18)		25.64(2.14)				-0.06(0.01)
ΔNEG_{t-3}		1.88(2.38)						17.20(2.34)
Panel B: Long-Run Estimates								
$\ln Y_{PAK}$	-0.74(2.28)	-1.59(2.29)	1.26(0.32)	5.91(1.28)	-0.75(0.39)	2.18(0.44)	-3.67(1.33)	-12.68(1.41)
$\ln Y_i$	1.05(2.91)	0.51(1.65)	-1.43(0.30)	-4.17(0.76)	3.37(1.19)	-0.42(0.50)	2.97(0.88)	3.29(1.91)
$\ln REX_i$	0.57(0.94)		6.01(1.72)		-7.56(2.04)		1.73(0.43)	
POS		1.00(1.30)		1.72(0.54)		3.92(0.77)		9.96(1.14)
NEG		-1.10(1.44)		5.88(0.85)		6.07(1.32)		-4.71(0.81)
Constant	-10.95(2.64)	25.97(1.36)	-9.08(0.24)	-32.09(0.25)	-46.33(1.83)	42.41(0.35)	8.56(0.26)	227.50(1.17)
Panel C: Diagnostic Statistics								
F test	6.46	4.35	4.51	4.32	3.25	2.57	10.43	7.02
ECM_{t-1}	-0.62(5.03)	-0.92(7.38)	-0.95(3.98)	-1.05(4.58)	-0.54(4.92)	-0.62(3.61)	-0.92(6.84)	-1.26(5.17)
LM	0.45	0.21	0.59	0.25	0.18	0.83	0.79	0.34
RESET	1.23	3.76	0.73	0.59	0.01	0.70	1.52	2.04
Adjusted R^2	0.61	0.73	0.50	0.56	0.52	0.37	0.72	0.78
$CS(CS^2)$	S(S)	S(S)	S(NS)	S(S)	S(S)	S(S)	S(S)	S(S)
$WALD - S$		4.76		9.11		2.09		11.81
$WALD - L$		15.31		11.43		1.50		10.01

Table 19: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and Saudi Arabia industry trade

	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL – ARDL				
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	0.0002(0.24)	0.00(1.33)	-4.92(1.88)	14.57(1.10)				
$\Delta \ln Y_{PAK,t-1}$				24.00(1.05)				
$\Delta \ln Y_{PAK,t-2}$								
$\Delta \ln Y_{PAK,t-3}$								
$\Delta \ln Y_{i,t}$	0.001(1.24)	0.00(0.23)	7.42(1.76)	3.88(0.92)				
$\Delta \ln Y_{i,t-1}$			5.53(1.83)	13.30(3.73)				
$\Delta \ln Y_{i,t-2}$			-3.59(1.29)	8.02(1.52)				
$\Delta \ln Y_{i,t-3}$			-6.77(2.46)	-10.82(3.49)				
$\Delta \ln REX_{i,t}$	0.001(1.14)		1.97(0.73)					
$\Delta \ln REX_{i,t-1}$	-0.005(3.63)							
$\Delta \ln REX_{i,t-2}$	-0.003(2.80)							
$\Delta \ln REX_{i,t-3}$								
ΔPOS_{t}		0.00(0.38)		-12.42(2.58)				
ΔPOS_{t-1}		0.00(0.50)		2.11(0.33)				
ΔPOS_{t-2}		0.00(1.10)		-11.47(2.28)				
ΔPOS_{t-3}								
ΔNEG_{t}		0.00(1.28)		14.48(1.26)				

	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL – ARDL				
ΔNEG_{t-1}		-0.01(1.34)		-29.25(1.63)				
ΔNEG_{t-2}				25.78(2.15)				
ΔNEG_{t-3}				16.28(1.25)				
Panel B: Long-Run Estimates								
$\ln Y_{PAK}$	0.000162(0.24)	0.00(1.30)	-5.92(2.15)	5.70(0.73)				
$\ln Y_i$	-0.000005(0.01)	0.00(2.29)	5.65(1.82)	3.75(1.42)				
$\ln REX_i$	0.006(2.91)		2.38(0.73)					
POS		0.00(2.07)		-5.65(0.97)				
NEG		0.01(3.75)		10.26(1.51)				
Constant	-0.023(2.03)	-0.02(0.70)	-3.71(0.15)	-232.20(1.46)				
Panel C: Diagnostic Statistics								
F test	19.20	14.28	6.24	5.71				
ECM_{t-1}	-1.44(9.41)	-1.42(8.11)	-0.83(4.70)	-1.15(2.66)				
LM	0.84	0.50	0.34	0.77				
RESET	1.44	1.00	0.07	0.44				
Adjusted R^2	0.71	0.71	0.46	0.69				
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)				
$WALD-S$		2.09		4.99				
$WALD-L$		1.87		4.32				

Table 20: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for Pakistan and United Kingdom industry trade

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	**NL –ARDL**	**L - ARDL**	**NL – ARDL**	**L - ARDL**	**NL - ARDL**	**L – ARDL**	**NL – ARDL**
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	1.24(2.21)	1.38(2.20)	0.21(0.15)	0.17(0.12)	-0.48(6.47)	-0.36(2.91)	0.66(0.13)	2.05(0.57)
$\Delta \ln Y_{PAK,t-1}$	-1.01(1.47)	-0.47(0.75)	-4.54(1.73)	-4.36(1.42)			24.77(4.39)	22.57(2.73)
$\Delta \ln Y_{PAK,t-2}$		-1.29(1.40)					-13.24(2.75)	-23.33(3.72)
$\Delta \ln Y_{PAK,t-3}$								13.35(2.39)
$\Delta \ln Y_{i,t}$	0.009(0.01)	0.77(1.11)	-0.15(0.07)	-0.17(0.08)	-0.17(0.92)	-0.12(0.77)	-15.69(2.34)	-1.92(0.40)
$\Delta \ln Y_{i,t-1}$	1.93(2.51)	-1.28(0.95)	4.96(1.45)	4.89(1.42)	1.35(2.25)	0.97(2.42)	-15.88(1.96)	-4.87(0.68)
$\Delta \ln Y_{i,t-2}$		-1.06(0.70)	-8.76(5.70)	-8.59(5.12)	-1.21(3.33)	-1.11(3.43)	32.71(2.52)	2.51(0.23)
$\Delta \ln Y_{i,t-3}$		1.12(1.64)	4.76(4.13)	4.58(3.39)			-27.91(2.69)	-8.42(1.11)
$\Delta \ln REX_{i,t}$	-0.06(0.34)		-0.32(1.70)		-0.02(0.51)		3.41(2.07)	
$\Delta \ln REX_{i,t-1}$	-0.35(1.43)				0.25(2.61)		-1.26(0.73)	
$\Delta \ln REX_{i,t-2}$	0.36(1.72)				-0.16(2.51)		3.56(3.44)	
$\Delta \ln REX_{i,t-3}$	0.24(1.60)							
ΔPOS_{t}		0.02(0.04)		-0.19(0.31)		-0.10(1.17)		2.75(1.40)
ΔPOS_{t-1}		0.14(0.43)						-0.08(0.05)
ΔPOS_{t-2}		-0.33(0.98)						-3.79(1.23)
ΔPOS_{t-3}		0.79(2.02)						5.13(2.23)
ΔNEG_{t}		0.05(0.08)		-0.46(1.51)		0.03(0.26)		-1.92(1.10)

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L - ARDL	NL – ARDL	L - ARDL	NL - ARDL	L – ARDL	NL – ARDL
ΔNEG_{t-1}		-0.64(1.18)				0.46(3.29)		3.90(1.43)
ΔNEG_{t-2}		0.45(1.86)				-0.33(3.54)		10.34(3.93)
ΔNEG_{t-3}								-9.07(3.47)
Panel B: Long-Run Estimates								
$\ln Y_{PAK}$	0.59(6.43)	2.41(1.59)	-1.80(1.36)	-2.14(1.99)	-1.00(-3.43)	-0.41(2.78)	-2.05(1.28)	-7.42(2.15)
$\ln Y_i$	-0.36(2.16)	-1.35(1.56)	3.56(1.47)	3.71(1.71)	1.90(3.8)	1.00(9.27)	2.59(0.80)	3.57(1.31)
$\ln REX_i$	-0.43(8.97)		-0.50(1.70)		-0.07(-2.11)		-0.98(2.08)	
POS		-1.31(1.67)		-0.29(0.31)		-0.11(1.27)		3.48(1.82)
NEG		0.52(0.63)		-0.69(1.63)		-0.02(0.22)		-4.44(2.31)
Constant	-2.59(1.03)	-21.73(1.24)	-0.52(1.54)	-50.30(1.10)	-27.85(4.19)	-17.69(8.55)	14.69(0.30)	82.85(1.72)
Panel C: Diagnostic Statistics								
F test	5.25	4.4	4.14	3.31	10.89	12.75	27.63	29.35
ECM_{t-1}	-1.03(4.62)	-0.87(2.38)	-0.64(5.83)	-0.66(5.44)	-0.48(3.09)	-0.87(5.94)	-1.30(13.88)	-1.33(10.66)
LM	0.29	0.54	0.15	0.28	0.01	0.90	0.75	0.26
RESET	0.10	0.01	4.30	4.17	9.23	0.01	0.003	0.01
Adjusted R^2	0.64	0.74	0.47	0.47	0.73	0.77	0.84	0.93
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)	S(S)	S(S)	S(S)	S(S)
$WALD - S$		1.87		0.98		1.06		14.23
$WALD - L$		3.33		1.67		1.33		32.87

Table 21: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and United Kingdom industry trade

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L – ARDL	NL – ARDL	L – ARDL	NL – ARDL	L - ARDL	NL - ARDL	L – ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	-0.37(1.49)	0.23(0.14)	0.52(0.09)	-5.59(1.13)	0.18(3.63)	0.16(2.93)	-4.68(1.44)	-7.43(1.91)
$\Delta \ln Y_{PAK,t-1}$		-0.16(0.04)	31.86(1.87)	31.08(3.78)	0.02(0.23)		14.90(1.12)	14.78(1.37)
$\Delta \ln Y_{PAK,t-2}$		-2.23(0.86)	-23.44(3.11)	-20.82(5.08)	0.16(1.65)		-11.42(1.64)	-10.80(2.16)
$\Delta \ln Y_{PAK,t-3}$					-0.12(1.71)			
$\Delta \ln Y_{i,t}$	-0.03(0.06)	1.89(1.69)	-14.83(3.95)	-7.32(2.04)	0.04(0.76)	0.09(2.11)	4.46(1.96)	6.86(1.86)
$\Delta \ln Y_{i,t-1}$		-1.65(0.41)	3.49(0.44)	-14.95(1.36)	0.09(1.09)	0.16(1.34)		-13.51(2.11)
$\Delta \ln Y_{i,t-2}$		-1.24(0.31)	2.11(0.27)	3.01(0.20)	-0.18(2.94)	-0.30(2.27)		-1.43(0.24)
$\Delta \ln Y_{i,t-3}$		3.97(1.64)	-9.54(1.65)	-8.53(0.91)		0.08(1.20)		5.73(1.75)
$\Delta \ln REX_{i,t}$	-0.17(1.68)		1.22(0.62)		-0.004(0.39)		-0.28(0.39)	
$\Delta \ln REX_{i,t-1}$			0.04(0.02)				1.82(1.90)	
$\Delta \ln REX_{i,t-2}$			-0.09(0.58)					
$\Delta \ln REX_{i,t-3}$			4.86(3.33)					
ΔPOS_{t}		-0.69(0.73)		3.00(0.86)		-0.01(0.43)		0.69(0.85)
ΔPOS_{t-1}		-0.61(0.92)		-4.27(1.31)				
ΔPOS_{t-2}		1.52(2.20)		-1.01(0.24)				
ΔPOS_{t-3}				5.96(3.60)				
ΔNEG_{t}		0.46(0.73)		2.61(1.40)		-0.01(0.56)		-0.07(0.06)

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L – ARDL	NL – ARDL	L – ARDL	NL – ARDL	L - ARDL	NL - ARDL	L – ARDL	NL - ARDL
ΔNEG_{t-1}		1.33(1.13)		10.85(3.64)				7.13(2.42)
ΔNEG_{t-2}		-0.97(0.78)		-6.12(1.33)				-3.89(1.84)
ΔNEG_{t-3}		-0.90(1.00)		8.44(2.27)				3.41(2.19)
Panel B: Long-Run Estimates								
$\ln Y_{PAK}$	-0.36(1.41)	3.35(2.22)	-0.47(0.29)	-0.46(0.14)	-0.02(2.48)	-0.06(1.44)	-1.97(1.84)	-2.80(1.53)
$\ln Y_i$	-0.03(0.06)	-2.81(2.46)	2.12(0.69)	1.67(0.74)	0.10(5.54)	0.12(3.51)	5.03(2.51)	4.59(2.08)
$\ln REX_i$	-0.16(1.43)		-0.77(1.35)		-0.02(14.72)		0.20(0.58)	
POS		-1.72(2.22)		-0.45(0.28)		-0.01(0.44)		0.60(0.86)
NEG		1.55(1.98)		-1.59(1.12)		-0.05(2.39)		-1.63(2.04)
Constant	11.47(1.45)	-3.31(0.19)	-41.11(1.00)	-32.64(1.00)	-2.05(8.23)	-1.95(4.44)	-89.04(3.05)	-57.56(2.20)
Panel C: Diagnostic Statistics								
F test	4.67	5.06	11.11	16.53	9.62	8.72	7.48	8.4
ECM_{t-1}	-1.02(6.07)	-0.91(5.77)	-1.03(7.70)	-1.18(9.83)	-1.51(5.09)	-1.09(6.14)	-0.88(5.44)	-1.14(4.59)
LM	0.17	0.42	0.31	0.44	0.67	0.13	0.87	0.25
RESET	0.64	0.92	2.07	3.49	13.33	1.98	3.72	2.43
Adjusted R^2	0.56	0.52	0.70	0.87	0.70	0.75	0.63	0.70
$CS(CS^2)$	S(NS)	NS(S)	S(S)	S(NS)	S(S)	S(S)	S(S)	S(S)
$WALD-S$		4.43		6.87		1.09		14.98
$WALD-L$		10.33		2.33		2.01		1.09

Table 22: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and United Kingdom industry trade

	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL – ARDL				
			Panel A: Short–Run Estimates					
$\Delta \ln Y_{PAK,t}$	2.40(1.72)	2.32(0.97)	1.06(0.40)	-6.20(1.56)				
$\Delta \ln Y_{PAK,t-1}$			28.50(2.20)	29.45(2.50)				
$\Delta \ln Y_{PAK,t-2}$			-6.23(1.05))	-14.28(2.49)				
$\Delta \ln Y_{PAK,t-3}$			-9.10(2.31)					
$\Delta \ln Y_{i,t}$	1.19(1.01)	1.42(1.09)	-11.38(3.13)	-5.29(1.54)				
$\Delta \ln Y_{i,t-1}$			-5.02(0.48)	-16.27(1.69)				
$\Delta \ln Y_{i,t-2}$			1.51(0.30)	6.32(1.65)				
$\Delta \ln Y_{i,t-3}$			6.44(2.00)					
$\Delta \ln REX_{i,t}$	-0.19(0.71)		-0.07(0.23)					
$\Delta \ln REX_{i,t-1}$								
$\Delta \ln REX_{i,t-2}$								
$\Delta \ln REX_{i,t-3}$								
ΔPOS_{t}		0.20(0.23)		1.61(2.56)				
ΔPOS_{t-1}								
ΔPOS_{t-2}								
ΔPOS_{t-3}								
ΔNEG_{t}		-0.60(0.87)		0.48(0.62)				

	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL – ARDL				
ΔNEG_{t-1}				8.32(2.19)				
ΔNEG_{t-2}				-5.40(2.31)				
ΔNEG_{t-3}				5.07(3.57)				
Panel B: Long-Run Estimates								
lnY_{PAK}	-0.65(1.31)	-1.21(0.98)	1.09(1.16)	-2.94(2.40)				
lnY_i	1.05(1.00)	1.25(1.09)	0.03(0.02)	3.26(1.66)				
$lnREX_i$	-0.17(0.74)		-0.05(0.22)					
POS		0.18(0.23)		1.37(2.80)				
NEG		-0.53(0.90)		-3.12(5.69)				
Constant	-12.35(0.70)	-4.99(0.22)		-17.20(0.57)				
Panel C: Diagnostic Statistics								
F test	10.77	9.22	7.59	10.69				
ECM_{t-1}	-1.13(10.89)	-1.13(10.39)	-1.06(3.93)	-1.17(7.67)				
LM	0.03	0.09	0.08	0.33				
RESET	0.87	1.29	9.09	14.20				
Adjusted R^2	0.54	0.54	0.77	0.83				
$CS(CS^2)$	NS	S(S)	S(S)	S(S)				
$WALD-S$		3.09		0.98				
$WALD-L$		1.10		0.56				

Table 23: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for Pakistan and Germany industry trade

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L - ARDL	NL – ARDL	L - ARDL	NL - ARDL	L - ARDL	NL – ARDL
Panel A: Short–Run Estimates								
$\Delta \mathbf{lnY}_{\mathbf{PAK,t}}$	-0.20(0.71)	-0.70(1.84)	4.09(0.69)	-6.04(1.84)	0.27(5.74)	0.63(5.15)	0.72(0.34)	-2.80(1.16)
$\Delta \mathbf{lnY}_{\mathbf{PAK,t-1}}$	-0.39(0.98)	1.45(1.79)	-7.60(0.91)			-0.02(0.11)	7.07(2.40)	16.78(2.84)
$\Delta \mathbf{lnY}_{\mathbf{PAK,t-2}}$	-1.24(3.01)	-1.38(1.52)	4.63(0.47)			0.00(0.00)	-6.76(2.27)	-15.07(3.55)
$\Delta \mathbf{lnY}_{\mathbf{PAK,t-3}}$		-1.65(2.18)	-19.49(2.22)			0.24(1.74)		
$\Delta \mathbf{lnY}_{\mathbf{i,t}}$	0.87(3.53)	1.22(2.38)	16.69(2.12)	11.64(3.04)	-0.92(3.75)	-1.05(4.36)	-2.95(1.06)	-0.80(0.23)
$\Delta \mathbf{lnY}_{\mathbf{i,t-1}}$	-1.85(4.48)	-1.33(1.44)	-14.52(1.62)		0.30(3.37)	0.36(3.25)	6.88(2.45)	0.85(0.29)
$\Delta \mathbf{lnY}_{\mathbf{i,t-2}}$	1.26(2.02)	0.21(0.25)	-13.45(1.64)				8.24(2.91)	6.62(2.28)
$\Delta \mathbf{lnY}_{\mathbf{i,t-3}}$		1.05(2.23)					5.98(2.24)	
$\Delta \mathbf{lnREX}_{\mathbf{i,t}}$	-0.01(0.23)		2.90(1.89)		-0.03(1.98)		-1.25(2.46)	
$\Delta \mathbf{lnREX}_{\mathbf{i,t-1}}$			1.13(0.61)				-1.40(2.57)	
$\Delta \mathbf{lnREX}_{\mathbf{i,t-2}}$			5.86(3.49)				-1.28(2.13)	
$\Delta \mathbf{lnREX}_{\mathbf{i,t-3}}$			2.49(1.90)				1.71(3.83)	
$\Delta \mathbf{POS}_{\mathbf{t}}$		-0.38(2.34)		1.22(0.76)		-0.06(1.43)		-3.44(2.27)
$\Delta \mathbf{POS}_{\mathbf{t-1}}$		0.11(0.38)				-0.03(0.68)		0.98(1.12)
$\Delta \mathbf{POS}_{\mathbf{t-2}}$		0.18(1.04)				-0.03(1.30)		-4.18(4.18)
$\Delta \mathbf{POS}_{\mathbf{t-3}}$						-0.08(2.24)		2.64(1.20)
$\Delta \mathbf{NEG}_{\mathbf{t}}$		0.29(1.00)		-0.95(0.35)		-0.03(0.89)		1.04(0.88)

	Animal and vegetable oils and fats		Beverages and tobacco		Chemicals		Commod. & transacts. Not class. Acc	
	L –ARDL	NL –ARDL	L - ARDL	NL – ARDL	L - ARDL	NL - ARDL	L - ARDL	NL – ARDL
ΔNEG_{t-1}		-0.30(0.94)		-10.75(2.75)		0.04(1.00)		-2.03(1.13)
ΔNEG_{t-2}		-0.37(0.96)				0.06(1.60)		1.93(2.14)
ΔNEG_{t-3}		0.65(2.83)						2.75(1.73)
Panel B: Long-Run Estimates								
lnY_{PAK}	0.31(3.30)	1.15(6.47)	-9.38(5.35)	-11.20(1.27)	0.11(11.44)	.10(7.00)	0.67(0.91)	6.56(2.13)
lnY_i	-0.71(2.94)	-1.21(6.70)	28.50(5.93)	21.57(2.04)	-0.18(6.69)	-0.22(9.96)	-3.86(1.82)	-8.80(1.43)
$lnREX_i$	-0.007(0.22)		-2.62(2.63)		-0.002(0.67)		0.24(0.48)	
POS		-0.48(4.66)		2.25(0.63)		0.02(1.47)		-3.18(0.42)
NEG		0.23 (4.10)		0.41(0.14)		-0.01(2.53)		0.44(0.42)
Constant	12.83(2.80)	6.32(1.76)	-565.90(6.02)	-336.19(2.75)	2.61(4.67)	3.63(5.16)	92.75(2.16)	91.22(0.42)
Panel C: Diagnostic Statistics								
F test	8.44	7.96	5.99	3.94	6.19	4.95	12.2	9.92
ECM_{t-1}	-1.35(4.93)	-1.73(5.68)	-1.50(5.06)	-0.54(2.75)	-1.10(8.36)	-1.12(6.51)	-1.10(7.72)	-0.75(3.94)
LM	0.97	0.003	0.53	0.47	0.73	0.56	0.43	0.62
RESET	6.00	4.55	6.39	2.62	6.02	6.79	7.59	2.22
Adjusted R^2	0.85	0.92	0.60	0.60	0.82	0.90	0.73	0.85
$CS(CS^2)$	S(NS)	S(S)	NS(S)	S(S)	S(S)	S(S)	S(S)	S(S)
$WALD-S$		0.54		8.87		4.60		8.09
$WALD-L$		0.90		11.30		5.56		27.09

Table 24: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and Germany industry trade

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L - ARDL	NL – ARDL	L – ARDL	NL – ARDL	L - ARDL	NL - ARDL	L – ARDL	NL - ARDL
Panel A: Short–Run Estimates								
$\Delta \ln Y_{PAK,t}$	-3.04(2.99)	-3.18(4.93)	-0.09(0.18)	-0.82(0.28)	-0.01(0.88)	-0.02(1.65)	0.08(0.10)	-0.61(0.57)
$\Delta \ln Y_{PAK,t-1}$	-3.31(2.27)	1.23(0.30)		12.77(1.76)	0.01(0.54)	0.08(1.82)	12.52(1.30)	10.13(1.03)
$\Delta \ln Y_{PAK,t-2}$	-3.96(2.54)	-0.04(0.01)		-15.80(3.75)	-0.05(2.53)	-0.08(2.22)	-7.91(1.53)	-4.36(0.84)
$\Delta \ln Y_{PAK,t-3}$	-6.29(4.35)	-2.52(1.06)						
$\Delta \ln Y_{i,t}$	2.65(1.88)	5.69(3.09)	-5.18(2.33)	-2.80(1.33)	0.01(1.01)	0.03(2.07)	3.05(1.84)	5.74(3.66)
$\Delta \ln Y_{i,t-1}$	6.07(4.18)	1.70(1.25)			-0.08(4.46)	-0.07(2.65)		
$\Delta \ln Y_{i,t-2}$	3.64(2.57)	4.31(3.81)						
$\Delta \ln Y_{i,t-3}$								
$\Delta \ln REX_{i,t}$	0.69(3.07)		0.54(3.60)		-0.001(0.33)		-0.39(1.43)	
$\Delta \ln REX_{i,t-1}$	0.98(3.24)				-0.006(1.78)			
$\Delta \ln REX_{i,t-2}$	1.31(4.71)							
$\Delta \ln REX_{i,t-3}$	0.88(4.04)							
ΔPOS_t		1.90(2.63)		-1.67(1.46)		-0.01(1.10)		1.48(3.53)
ΔPOS_{t-1}		0.24(0.41)		1.95(1.81)				
ΔPOS_{t-2}		-0.71(1.68)						
ΔPOS_{t-3}		1.77(2.94)						
ΔNEG_t		-1.37(1.94)		3.24(1.35)		0.00(0.02)		-1.82(4.88)

	Crude materials, inedible, except f		Food and live animals		Machinery and transport equipment		Manufact goods classified chiefly b	
	L - ARDL	NL – ARDL	L – ARDL	NL – ARDL	L - ARDL	NL - ARDL	L – ARDL	NL - ARDL
ΔNEG_{t-1}		-0.85(1.16)		-3.70(1.88)		-0.02(2.23)		
ΔNEG_{t-2}		1.90(2.46)		3.14(1.95)		0.01(1.59)		
ΔNEG_{t-3}		-1.63(7.96)						
Panel B: Long-Run Estimates								
lnY_{PAK}	0.78(1.77)	-2.15(3.49)	0.13(0.17)	7.69(4.04)	0.02(2.65)	0.05(2.74)	-1.04(1.76)	-4.84(5.09)
lnY_i	-2.52(1.93)	0.57(0.45)	1.32(0.28)	-3.02(1.27)	-0.06(2.44)	-0.07(2.90)	3.52(2.20)	5.93(4.44)
$lnREX_i$	-0.41(2.21)		0.81(1.55)		0.009(2.26)		-0.44(1.55)	
POS		0.74(1.26)		-3.63(2.83)		-0.01(1.14)		1.53(4.33)
NEG		-1.29(6.17)		3.00(4.17)		0.02(2.47)		-1.89(7.10)
Constant	55.30(2.12)	37.23(1.07)	-37.21(0.94)	-101.26(1.67)	1.26(2.29)	0.84(2.18)	-71.10(2.31)	-48.92(2.63)
Panel C: Diagnostic Statistics								
F test	6.14	2.87	5.21	5.81	8.54	3.71	6.07	7.01
ECM_{t-1}	-1.20(7.67)	1.63(7.96)	-0.66(4.60)	-0.93(6.29)	-0.68(6.61)	-0.70(4.58)	-0.87(7.38)	-0.97(10.26)
LM	0.57	0.07	0.09	0.68	0.95	0.84	0.97	0.62
RESET	0.97	0.83	3.98	6.35	7.39	2.52	0.20	0.29
Adjusted R^2	0.71	0.85	0.43	0.61	0.76	0.78	0.50	0.62
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)	S(S)	S(S)	S(NS)	S(S)
$WALD - S$		16.20		19.09		7.68		12.09
$WALD - L$		4.67		13.65		0.91		9.09

Table 25: Linear ARDL (L-ARDL) and Nonlinear ARDL (NL-ARDL) Models for PAK and Germany industry trade

	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL – ARDL				
				Panel A: Short–Run Estimates				
$\Delta \ln Y_{PAK,t}$	4.60(1.13)	-4.04(0.75)	0.46(2.81)	0.28(2.33)				
$\Delta \ln Y_{PAK,t-1}$		6.67(0.67)		0.35(1.44)				
$\Delta \ln Y_{PAK,t-2}$		7.60(0.92)		0.31(1.69)				
$\Delta \ln Y_{PAK,t-3}$		-18.11(2.50)		-0.48(3.73)				
$\Delta \ln Y_{i,t}$	-2.28(1.23)	8.57(1.34)	-0.71(3.80)	-0.59(3.74)				
$\Delta \ln Y_{i,t-1}$		-36.91(2.07)	0.44(2.62)	0.55(2.29)				
$\Delta \ln Y_{i,t-2}$		52.47(3.26)	-0.31(3.37)	-0.46(3.24)				
$\Delta \ln Y_{i,t-3}$		-29.15(3.99)						
$\Delta \ln REX_{i,t}$	1.98(1.61)		0.06(1.61)					
$\Delta \ln REX_{i,t-1}$	-2.65(1.48)		-0.002(0.14)					
$\Delta \ln REX_{i,t-2}$	2.40(3.09)		0.03(1.99)					
$\Delta \ln REX_{i,t-3}$			-0.05(4.77)					
ΔPOS_{t}		5.01(1.96)		-0.04(0.70)				
ΔPOS_{t-1}		-8.94(3.72)		0.15(2.06)				
ΔPOS_{t-2}		7.28(2.56)						
ΔPOS_{t-3}		4.21(2.02)						
ΔNEG_{t}		-2.21(1.60)		0.10(2.16)				

	Mineral fuels, lubricants and relat		Miscellaneous manufactured					
	L - ARDL	NL – ARDL	L - ARDL	NL – ARDL				
ΔNEG_{t-1}				-0.12(2.51)				
ΔNEG_{t-2}				0.11(4.58)				
ΔNEG_{t-3}								
Panel B: Long-Run Estimates								
lnY_{PAK}	6.70(1.20)	3.88(0.90)	0.07(0.60)	0.05(0.42)				
lnY_i	-3.31(1.31)	-0.79(0.44)	-0.02(0.45)	0.04(0.84)				
$lnREX_i$	0.36(0.29)		0.06(1.51)					
POS		-3.79(5.19)		-0.15(2.52)				
NEG		-1.43(1.70)		0.006(0.17)				
Constant	-74.88(1.04)	-73.37(1.25)	-1.20(0.75	-2.38(1.50)				
Panel C: Diagnostic Statistics								
F test	14.12	18.64	9.42	11.4				
ECM_{t-1}	-0.68(3.71)	-1.54(1.37)	-1.02(6.22)	-1.24(9.29)				
LM	0.76	0.12	0.36	0.17				
RESET	2.55	2.87	1.98	6.13				
Adjusted R^2	0.71	0.88	0.78	0.91				
$CS(CS^2)$	S(S)	S(S)	S(S)	S(S)				
$WALD-S$		10.33		17.21				
$WALD-L$		0.56		8.70				

The short & long run estimates along with diagnostic statistics are given in the above table. By examining the outcomes of nonlinear model, the study put light on the further evidence that are apparent in the nonlinear model however were missing in the linear model. To start with, we review that on account of the linear model just 42 industries show any short-run exchange rate impact on the balance of trade. On account of nonlinear model, either ΔPOS or ΔNEG convey not less than one significant coefficient for the 49 industries. Moreover, the nonlinear model enables us to make a different evaluation about the time it takes for the balance of trade to modify because of depreciation versus the appreciation of the rupee. This opportunity was absent on account of the linear model. The short-run estimates demonstrate that ΔPOS and ΔNEG take distinctive slack/lag lengths in the instances of 36 industries showing asymmetric short-run exchange rate impact on balance of trade on account of these industries. Furthermore, coefficients of ΔPOS and ΔNEG vary in terms of the sizes as well as signs over the industries. Along these lines, an appreciation and depreciation/devaluation of the rupee has distinctive short-run consequences for the balance of trade over the industries. Once more, such informations were absent in the linear model. At long last, we take note of the Wald test as reported by Wald-S is critical in the instances of 47 industries. In this manner, there is persuading and solid proof in support of short-run cumulative effect of exchange rate on the trade balance of these industries.

Panel B and C composition demonstrate that the short-run impacts of the rupee depreciation/devaluation or appreciation convert into important long-run impacts and is upheld by the test of cointegration in case of 38 industries. This illustration held for just 22 industries in the linear model and we credit this expansion to the nonlinear impacts of the exchange rates. Moreover, either the variable POS or the NEG convey a positive and significant coefficient for 26 industries. At the same time, in the short-run this group of industries indicate deterioration (advancements) of balance of trade because of the depreciation (appreciation) of the rupee. Following Bahmani-Oskooee and Fariditavana (2015), we accept this as confirmation for the 'J-Curve' in the case of these 26 industries. Conversely, the linear model yields the similar pattern just for the 8 industries. At last, it is vitally important to note that the asymmetric long-run impacts of exchange rate is significant in the instances of 34 industries as proved by the significance of Wald test reported by the Wald-L.

The linear and nonlinear model long-run results suggest that the trading partner’s income (GDP) has a positive and significant effect on the trade balance of 21 industries. Which means that as the trading partner economy grows, there demand for this product also grows and they import more of these commodities from Pakistan to meet their higher demand. So, Pakistan export of these goods increases. On the other hand, there are 12 industries whose trade balance shows negative association with the income of trading partners, which means that as their income increases, they start producing its substitute instead of importing it. As Pakistan imports to them decline and thus a negative sign for trade balance.

The income (GDP) of Pakistan has positive effect on the trade balance of 9 industries which shows that the growth in income will ultimately lead to produce more and export more thus a positive signal for trade balance. On the other hand, there are 21 industries whose trade balance shows negative connections with Pakistan income which mean that as the income of Pakistan increases, people tend to increase their demand to the products of these industries as a results exports of these industries decline and make a sharp increase in imports thus a negative signal for the trade balance.

5.5 Diagnostic Statistics

In our study we use several diagnostic tests to make our results reliable. Lagrange multiplier statistic with four degrees of freedom has been used to ensure no autocorrelation in the residual. We found that most of our results are reliable as there is no autocorrelation. For model specification we use Ramsey's reset test with one degree of freedom. We find insignificant statistics ensuring that models are correctly specified. For the short and long run coefficient stability we use CUSUM and CUSUM square following Pesaran et al. (2001). In Panel C, models with stable and unstable estimates are indicated by 'S' and 'NS' respectively. Our results suggest that most of our models are stable. In order to check the goodness of fit, we included R^2.

CHAPTER 6

CONCLUSION AND POLICY RECOMMENDATION

6.1 Introduction

The general relationship between macroeconomic variables is nonlinear (Mohsen Bahmani-Oskooee, Niloy Bose & Yun Zhang, 2017). The researchers are agreeing on the rejection of symmetry assumption and looking for an alternative framework that is suitable and can capture asymmetric effects of independent variables. In this study, we took the development seriously and used the reduced form bilateral trade model proposed by Shin et al (2014), for commodity trade between Pakistan and his major six trading partners. We extended the work of Mohsen Bahmani-Oskooee, Niloy Bose & Yun Zhang (2017) adding several improvements and disaggregating trade flaws to avoid aggregation biasness. Pakistan Industry level trade with China, Saudi Arabia, Japan, United States, United Kingdom, and Germany has been the subject of consideration in this study.

For the symmetric analysis, we employed three econometric procedures. Firstly, the augmented Dickey fuller test is employed to check the unit root problem in the data series and confirmed a mixed order of integration of the variables. Secondly, we checked the Cointegration among variables through ARDL bound test and found that the F-statistics for all industries falls above the upper bounds from the critical values at the significance level of 5 and 10 percent except for some industries discussed in chapter 4^{th}. For these industries as suggested by Canetti (1991) and Kremers et al. (1992) Error correction model (ECM) is applied and found the existence of Cointegration among the variables, which means that there is long-run Cointegration among the variables for all industries. Thirdly, in order to estimate the short-run, long run and error correction term coefficient we use ARDL model and to capture the asymmetry, Nonlinear ARDL model is used.

6.2 Key Findings

The symmetric analysis which is carried out by utilizing linear ARDL model yields that 42 industries balance of trade is affected by the exchange rate in short-run, these industries are engaged in export and import between Pakistan and its trading partners. 22 industries show that the short-run effect of exchange rate converts to long-run and j-curve for 8 industries. The income (GDP) of trading partner positively affect 21 industries balance of trade while the negative effect is observed on the trade balance of 12 industries. For asymmetric analysis, nonlinear ARDL model is engaged in the present study. The results show that 49 industries trade balance in the short run are being affected by either POS and NEG changes in exchange rate. 36 industries trade balance is being affected by the different slack/lag structure of either POS or NEG changes in exchange rate. Furthermore, the results show that short and long-run impact asymmetry is being observed in 47 and 34 industries respectively. 38 industries balance of trade which is affected in short-run by exchange rate converts to long-run effect, in which 26 industries balance of trade gave an indication that in the long-run either POS and NEG changes in exchange rate carry positive coefficient. The J-curve is being observed in the instances of 25 industries. 9 and 21 industries show a negative and positive association with exchange rate respectively. It makes us realize that the effect of devaluation on the trade balance is very slow and limited to some industries. which give us the indications that sharp exchange rate fluctuation hurt most of the industries trade balance and hence a country's total trade balance.

6.3 Policy Recommendations

The study derived important policy implications such as the elasticity approach towards the balance of payment is not profoundly effective so the policymakers should look towards the income and monetary approaches as well. secondly, NER devaluation does not always translate into the RER devaluation. Thus a policy of nominal devaluation will only be successful if it translates into real devaluation, which can only occur if the domestic prices do not increase significantly relative to the foreign prices.

Additionally, rather relying on the external policies intending to perk up trade balance, the Govt should focus on the internal supply side that gives a suitable environment so the exportable and import substitute goods can be produced. The findings of the study suggest that total reliance on the external policies (devaluation/depreciation) wouldn’t work to bring improvements in the trade balance since these countries are price takers from the international market and would not be capable to affect the external demand effectively for the exports of goods by the incentives produced by the prices changes after devaluation. However, currency devaluation remains significant policy instrument to improve trade balance for many of the industries in trade between Pakistan and its trading partners.

it is also suggested that the government should adopt the policies that focus on improving Pakistan’s real GDP in order to improve the TB. For this reason, the policymakers should adopt such energetic approaches that can promote the agricultural and manufacturing sector's production, in order to meet foreign and local demand for our goods and services, Government should encourage foreign investors to invest in the manufacturing and agricultural sectors so it may improve real GDP and thus industries trade balance.

6.4 Limitations and Future Research Directions

This study used 1-digit industry trade balance which can be disaggregated to further digits. The study took the trade relation of Pakistan with 6 major trading partners, a study can be done while considering the all trading partners of Pakistan.

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