EXCHANGE RATE NONLINEARITIES IN PAKISTAN'S MAJOR EXPORTS AND IMPORTS

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CERTIFICATE

This is to certify that this thesis entitled: **"Exchange Rate Nonlinearities in Pakistan's Major Exports and Imports"** submitted by Mr. Dilavar Khan is accepted in its present form by the Department of Economics & Econometrics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree of **Master of Philosophy in Economics.**

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ABSTRACT

This study on "Exchange Rate Nonlinearities in Pakistan's Major Exports and Imports" is an effort to study Pakistan's exports and imports and their nonlinear association with the changes in the value of Pak Rupees with respect to USD. It establishes empirical evidence if exchange rate depreciation and its advocated positive impact on the correction of balance of trade is really valid in case of Pakistan. Instead of using only the Linear Auto-Regressive Distributed Lag (ARDL) Bound Testing Modeling, this study also uses the Non-Linear Auto-Regressive Distributed Lag (NARDL) Bound Testing on Nominal as well as Real exchange rate determinants. Pakistan's major export and import categories, as categorized by the State bank of Pakistan, including food, machinery, transport, petroleum, textiles, agricultural & other chemicals, metals, and grand totals are analyzed using monthly data of years 2003 through 2019. The study uses the opportunity to analyze Pakistan's total trade with rest of the world (all countries) using United States of America's trade as a proxy for this purpose. It is found that the nonlinearity exists only in nine of the thirty two estimations. Therefore, as per this study's findings, nonlinear impact of the exchange rate may not be applied as rule of the day on all of the foreign trade conducted by Pakistan with its trading partners. Further, the estimation of the Marshal Lerner Condition reveals to have two outputs based on the choice of exchange rate as: first, the absolute sum of export and import elasticities totals to be exactly one implying there would be no impact of currency depreciation on the trade balance if nominal exchange rate is used as a key determinant; On the other hand if real exchange rate is the main determinant of trade balance correction, than the absolute sum of export and import elasticities is 0.8 that is less than 1. Hence, it means the MLC does not meet and the trade balance of Pakistan would deteriorate if the Pak Rupee is depreciated against USD. Finally, the study finds that there is not much difference between the usability of real or nominal exchange rate as key determinant of trade balance of Pakistan. However, only in conjunction with MLC, the RER may be preferred over NER based on the matching of real data vs the estimated output results.

Keywords: Economics, Exchange Rate, Nominal Exchange rate, Real Exchange Rate, Linear and Nonlinear ARDL, Marshal-Lerner Condition, Asymmetric Effects Pakistan, The World, United States

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ADF	Augmented Dickey–Fuller
ARDL	Linear Auto-Regressive Distributed Lag
ECM	Error Correction Model / Mechanism
ECT	Error Correction Term
ER	Exchange rate
Ln	Natural log
MAO	Import All Others
MCG	Import Agricultural and Other Chemical
MFO	Import Food Group
MGT	Import Total Imports Payments through Banks
MLC	Marshal Lerner Condition
MMG	Import Machinery Group
MMI	Import Miscellaneous Group
MMT	Import Metal Group
MPT	Import Petroleum Group
MTG	Import Transport Group
MTX	Import Textile Group
NARDL	Non-Linear Auto-Regressive Distributed Lag
NER	Nominal Exchange Rate
PBS	Pakistan Bureau of Statistics
PKR	Pak. Rupees
RER	Real Exchange Rate
Rs.	Rupees
SBP	State Bank of Pakistan
US	United States of America
XAO	Export All Others
XFO	Export Food Group

XGT	Export Total Export Receipts through Banks
XOM	Export Other Manufacture
XPT	Export Petroleum Group
XTX	Export Textile Group

Chapter 1

Introduction

1.1. Introduction

Devaluation or depreciation[1] are expected to reduce the imports and improve the export volume through increased cost and reduced prices of the two trades respectively. However, it is of equal importance to know if the depreciation and appreciation have an equal impact on the changing behavior of the foreign trade i.e. if the impact of exchange rate changes on the trade determination is linear or nonlinear in nature. The phenomenon was first explained thoroughly by Alfred Marshall during early 1920s and Aba Lerner in 1940s. They established a necessary condition for the devaluation to be fruit full which is known as Marshall Lerner Condition (MLC). It states that if the sum of the demand elasticities of import and export are greater than one, the trade balance would initially deteriorate and finally in the long run would improve the balance of trade also known as the J-Curve theory. In later years there has been a split between the linear and nonlinear nature of the impact of the exchange rate, making the foundations for this study.

There exists mixed evidence of J-Curve relationship between Pakistani Rupee devaluation and balance of trade correction. According to Rehman & Muhammad (2003) there is no short run as well as long-run relationship between these two variables. Similarly, Rehman et al. (2012) have concluded the absence of short as well as long-run relationship between the trade balance and exchange rate devaluation measures. Kang (2016) analyzed that the devaluation did not help countries as strongly as it has always been expected. The export growth was almost equal in the countries facing currency depreciation as it was for the currency appreciation countries. Similarly, Hassan (2018) found, on commodity wise bilateral BoT that some of the industries are responsive to the exchange rate depreciation and others are non-responsive. Therefore, the existing literature leads to indecisive results. Existing studies cannot pin point the commodities, overall responsive to the devaluation. This study aims to explore the non-linearity of exchange rate on Pakistan's major exports

[1] A **devaluation** is a deliberate lowering the foreign exchange value of the currency by the government in a managed **exchange rate**. A **depreciation**, on contrary, is fall in the value of a **currency** in a free float exchange rate regime.

and imports. The export and imports are to be categorized as food, machinery, transport, petroleum, textiles, agricultural & other chemicals, metals, miscellaneous, others and grand total of imports and exports. The study is to be made on overall level rather than on bilateral level, so that it depicts a clear picture about which industries are responsive to the devaluation and therefore in which sector the import substitution is expected to take place and also which industries are not going to face any demand change despite the devaluation. Therefore, the results offered here would be more rigorous and conclusive.

The countries which are rich in natural resources, such as the Oil Producing and Exporting Countries, or the industrially advanced countries have the essentials of exports which the world needs, hence they are reaping the benefits in international trade. At the same time countries which do not have enough to offer to rest of world but contrarily need essentials to be imported are falling behind rest of the world. Developing countries like Pakistan depend heavily on imports of oil, machinery and medicines which they themselves can't produce. These countries either lack natural resources or the infrastructure and institutional framework to stabilize their economy through utilization of local resources rather than the dependence on foreign nations.

The modern world countries have to balance their accounts on annual basis. These accounts include: Current, Capital and Financial accounts. If countries' income is less than the expenditures, the difference is to be met through other sources, such as aid, local or foreign debts. This is called Balancing the Budget. Similarly, when countries carry international trade, they are affecting the trade account that is a component of Current Account. If imports are higher than the exports the balance of trade or BoT is in deficit and if the other way around the BoT is a surplus.

Balance of trade is a major component of current account of a country. A surplus current account is considered to be an indicator of the economic growth of the country. BoT can play a significant role to bring the current account in surplus. As discussed earlier, if the nation has a natural abundance of marketable resources, the country's BoT is expected to be in surplus. Also, if the country specializes in technological advancement then it can have a positive BoT balance. But if the country is having more imports than the exports, there

is BoT deficit. In the last case countries really have to do a lot of efforts to turnaround the deficit into surplus. In efforts to promote Exports and reduce imports counties opt devaluing its currency. This is expected to reduce the imports as the imports become more expensive for domestic users and at the same time the exports become cheaper for foreign buyers as the same commodity costs them less in the foreign currency units (Rehman *et al.* 2012; Stucka, 2004). This will ultimately correct the deficit BoT into surplus in the long run.

Does the so far discussion support that all the countries who face a deficit BoT should devalue their currencies in order to take a turn around? In order to rely upon similar strategy in Pakistan, the economic circumstances of Pakistan need to be understood, which is taken care of in the following section.

Pakistani currency was initially, after the independence, was linked to Pond Sterling, then in 1972 Pakistan Rupee was fixed against the USD at the rate of Rs. 9.90 a dollar that continued for a decayed. During this period, although the trade balance of Pakistan was in deficit, yet it was not as high as it is turned out to be in upcoming years. In 1982 Pakistani foreign exchange rate was led by managed float against a basket of currencies, adjusted by respective trade weights (Khan, 1994). Soon after 1990, the trade balance of Pakistan started to fluctuate heavily. In 1998 a multiple exchange rate was adopted. This system consisted of an official USD pegged exchange rate, a between the banks floating Interbank Rate and a combination of the two rates called a composite rate. During all these years, large fluctuations were there and trade balance did not show any sign of recovery or going into surplus. In 1999, the already existing three rates were abolished and again, this time with USD, pegged exchange rate was implemented with a limited band variation allowed in it based on the market condition. It may be called managed float exchanged rate. However in 2000 the pegged exchange rate was dismantled and a float exchange rate was put into action (Bano, Raashid, & Rasool, Estimation of Marshall Lerner Condition in the Economy of Pakistan, 2004). After the 2000s exchange rate policy shift, the trade balance has worsened that can be visualized in the graph that follows.

Pakistan is and has been facing a chronic Balance of Trade (BoT) deficit, so is the case of budgetary deficit. Currency devaluation is being advocated at large scale as a remedy to

this problem. This has also been carried out since inception, as discussed earlier. Despite consistent devaluations to cope up with worsening situation of Pakistan's BoT deficit, Pakistan has failed to see much real and effective positive change caused by currency devaluation.

The recent Imports and Exports are as follows which show that the Imports are far more than the imports[2]. The *figure 1* (Appendix A) shows the highlights of the Pakistan's yearly data on Imports and exports for the year 2015 through 2019. This depicts that the imports have always been higher than the exports and the gap has been swelling over the years.

Similarly the monthly data in *figure 2* (Appendix A) also clearly depicts the gap between the higher imports and lower exports.

At the same time when Pakistan is importing more than it is exporting, Pakistan's currency has been devaluing persistently. The following graph in *figure 3* (Appendix A) is self-evident in this respect[3].

The above discussed graph matches the floating exchange rate regime that begin in 1982 (Malik, et al., 2015). The exports, imports and the resulting trade deficit / surplus of the coinciding time period is presented in *figure 4* (Appendix A) that also shows that trade balance deficit widened when the currency depreciated[4].

Further, the graph in *figure 5* (Appendix A) shows the Pakistan BoT since 1980's[5]. It is very clear that despite every effort of controlling trade deficit by the means of exchange rate fluctuation has not been so fruitful.

These graph portrays trade balance of the Pakistan on vertical axis since 1985. There has been an overall negative trend. Despite short upward spikes, BoT deficit has dominated and couldn't make a surplus.

[2] http://www.sbp.org.pk/ecodata/exp_import_BOP.pdf
[3] http://www.sbp.org.pk
[4] http://www.pbs.gov.pk/content/annual-and-quarterly-terms-trade-and-unit-value-indices-exports-and-imports
[5] http://www.pbs.gov.pk/content/annual-and-quarterly-terms-trade-and-unit-value-indices-exports-and-imports

Pakistan's economy has seen BoT surplus only twice in its entire history: 1951-1952 and 1972-1973 (Mohammad, 2010). During 1951-1952 Pakistan exports went up due to the high volume of Jute exports. On the other hand for the 1972-1973 fiscal year the imports were suppressed due to the high taxes imposed on the luxury goods as well as the devaluation of the Pak rupee that boosted the export value of the Pakistani exports. In 1973 the oil was major import of the country and the change of oil price from USD 3 a barrel to USD 12 pushed the BoT further down again.

According to Malik, et al. (2015) during floating exchange rate regime of 1982–2008, imports grew at faster rate than that of exports. In 1982 Pakistan's exports declined by 10.3 percent whereas imports surged by 11.1 percent. For the subsequent 10 years the growth rates had been mixed. For 1992, despite the exports improved by 24.2 percent, the imports overshadowed it by showing a growth of 34.4 percent for the same period. From 2002 onwards, the imports have been growing at a faster pace than that of the country's exports. This has worsened that BoT of Pakistan. In BoT graph above, it is evident that the situation deteriorated sharply, plunging the country in sever BoT deficit. Since the beginning of new millennia the imports grew very sharply as the country's need for machinery, petroleum products, chemicals, steel and transport equipment rose. The major use of the imports was consumption rather than the production of exportable. This is evident by the structure of exports of 1999 to 2008, it mainly remained the same as major exports were agricultural products of which cotton being the major export contribution about 60 percent and textile being 5 percent. Further the deteriorated trade balance was the result of exports to limited number of countries, rather than diversified export market.

The above discussion and evidence shows that the Pakistani economy has been facing consistent higher imports and lower exports. The currency devalue has been advocated by the Marshal and Lerner as a mean to correct the trade balance. According to them if the domestic currency is devalued with respect to the trading partners, there would be two channels to correct the BoT. The imports into the country would become expensive for the domestic buyers, and hence they would demand less, making the import bill smaller. On the other hand, when the country's currency becomes cheaper, the foreign buyers can buy more of the devalued currency's country goods, enabling higher exports. Pakistan's

currency has always been devalued relying on this principal. However, there is also need to consider other assumptions of the Marshal Lerner Condition (MLC) that has been explained earlier and also being repeated here: the devaluation can improve trade balance of a country, if the sum of the trade elasticities exceeds unit (1). Therefore, this condition is a must to be observed before any practical application is made to the effectiveness of MLC.

After considering above facts and figures and discussion, one ponders what has gone wrong. Don't the devaluation theories which advocate that currency devaluation would correct macro variables such as BoT (Laetitia & Hongbing, 2019) hold in case of Pakistan? Or are there some other factors (Katseli, 1983) which need to be focused before the currency devaluation is effective?

In order to fully understand the nature of Pakistan Economy, it is very important to analyze Imports and Exports at disaggregate level. Further it is of equal and vital importance if the exchange rate used ought to be real or nominal. According to Katseli (1983) and Gosh (1990) the relationship between nominal and real exchange rate is ambiguous. And many of the study do not portray the true results because of sole reliance on the exchange rate instrument. This can also be evidenced by the number of other studies using diverse exchange rate in their studies like Nominal Exchange Rate (NER) nominal Effective Exchange Rate (NEER), Real Exchange Rate (RER) Real Effective Exchange Rate (REER) and Bilateral Exchange Rate (BER). Large number of studies using nominal exchange rate include Hassan (2018) and still a huge number of studies using real exchange rate Shahzad, et al. (2017), Hassan (2018).

There is a need to spotlight the relationship of currency devaluation in nominal terms on the disaggregate volumes of Imports and Exports and find out the net impact in short and long run. Further, the history shows that Pakistan has been facing BoT Deficit, as explained earlier, despite it has been devaluing its currency.

It is of vital importance to understand the nature of relationship between Currency Devaluation and BoT in order to get the BoT back on track. If the relationship is understood and the country knows when devaluation is needed and what are the prerequisites of

devaluation to produce the desired economic outputs only then this strategy can be meaningful. This research is an attempt to shed light on the relational aspect between traded commodities and the nature of exchange rate that influences the Pakistani international trade with rest of the world.

1.2. Research Gap

The previous studies either focus on linear or nonlinear; real or nominal exchange rate impact on trade balance or export & import or they focus on commodities at bilateral trade between Pakistan and other nations. Number of studies have used Nominal Exchange rates and still a huge research has used real and real effective exchange rates. However, if the policy makers need to find which of the import or export industries are responsive to the devaluation while considering Pakistan's trade with rest of the world, and or to know if the association is linear or nonlinear and or if the trade is responsive to the nominal or real exchange rate, a comprehensive study is not readily available at hand. So there is a need to have a study that uses Linear as well as nonlinear impact of nominal as well as real exchange rate on the import and export groups defined by the State Bank of Pakistan with rest of the world. Previous studies lack this approach to study the Pakistani exchange rate and its impact on Pakistan trade balance using the data compiled by the State Bank of Pakistan on industrial classification.

1.3. Research problem

The literature flops to give conclusive evidence whether the exchange rate in Pakistan effects the trade balance in a linear or nonlinear fashion. Further, previous studies also give inconclusive results on the feasibility of using nominal or real exchange rate as a policy tool. Therefore, there is a high need of studying all of these factors together to identify the true relationship between trade balance and exchange rate. As a result, industries cannot be pin pointed which respond favorably so that the alternative mechanism, such as setting up industries to substitute the imported product with the domestic product, be defined.

1.4. Research Questions

This research is designed to answer the following questions.

1. Do Pakistani imports and exports respond linearly or nonlinearly to the changes in exchange rate?
2. Is nominal or real exchange rate the true determinant of the trade balance variation?
3. What are the import & export component (industrial level) as well as overall trade balance elasticities?

1.5. Objective of the study

This study aims to achieve following ends using sectoral / industrial level of imports and exports of Pakistan:

1. To identify if there exists linear or nonlinear association between exchange rate and the import and export categories of Pakistan.
2. To determine the usability of either nominal or real exchange rate as a determinant to Pakistani trade balance.
3. To test the MLC using imports and exports elasticities to calculate the trade balance elasticity.

1.6. Significance of the study

This study aims to find if Pakistan's imports and exports respond linearly or nonlinearly to the changes in the exchange rates of Pakistani Rupee and also the elasticity at industrial level for all the industry classifications maintained by the State bank of Pakistan. This will demonstrate which industries are responsive to the depreciation and or appreciation, irrespective of the trading partner. As a result, it would be plausible to use the information to further assist decision making to harvest the benefits of the devaluation. Secondly the study would provide evidence, if the nominal exchange rate be used for elasticity studies or the real exchange rate.

Although Rehman et al. (2012) and Hassan (2018) worked extensively on this topic, however this study has edge over both of these studies. Rehman et al. (2012) conducted the study for the case of Pakistan as on aggregate level of trade. However, studies suggest that there can be aggregation biasness. Hassan (2018) and this study addresses the issue of aggregate biasness, yet there is remarkable difference between the former and this study.

This study uses the Pakistan major commodity trade between Pakistan and rest of the world rather than bilateral trade between Pakistan and its major trade partner. In the former case, the trade partners become more important than the commodities, whereas the situation should be the other way around; the commodities focus study. Apart from that, this study also includes the impact of the Global Financial Crisis 2007-2008 in the form of structural break introduced in the analysis. Making this study more robust than any of its predecessor studies.

Chapter 2

Literature Review

2.1. Introduction

In order to establish how the researchers across the globe have so far observed the phenomena of the impact of exchange rate changes on the country's trade balance, a comprehensive literature review is a beacon. It gives a significant understanding of the subject matter. The chapter two first focuses on the international as well as national literature. It enlightens about the existing work of the researchers. In the second section of the literature review chapter, the existing work has been summed up so that it becomes simpler to understand the vast literature diversity.

2.2. International and National Literature

Although the application of currency devaluation to correct country's BoT is widely accepted and strongly recommended by the IMF, it has also long been acknowledged that the application of exchange rate variation to fine tune BoT heavily depends on the structural characteristics of the economy in consideration. The literature highlights following three assumptions for making the devaluation effective; (I) perfect substitution of goods and assets - in essence one composite good with given price, (II) Price taker country in assets and goods markets, and (III) all Prices and wages are flexible making fixed output as economy is running at its full-employment. Further there is yet no clear and definite association established between the real exchange rates and the nominal ones, theoretical literature is abounded with examples of cases in which the economy's structure is such that Nominal exchange rate does not affect the real exchange rate and hence a devaluation makes a negative effects on both output and the price level. As a result, due to increased costs of the goods, devaluation effects on the BoT would depend on the initial trade balance. If the initial deficit was large, the devaluation would magnify it. The quantity exported is expected to be reduced provided high import content are used in exports (Katseli, 1983).

In early 1950s South Korea decided to base its economy on export led growth. As a result it set sails to lay Foundations for import substituting industrialization (ISI) that was

expected to set the economy in the right direction. Series of reforms were carried during 1954-1966 that included policy stabilization, currency devaluation, and import liberalization in selected sectors. It is to be noted that economic strategy of South Korea was far from free trade. Heavy investments were made in establishing Import Substitution sectors and along with this Export Promotion Subcommittee (EPSC) was established to promote local products abroad. The EPSC played vital role in collaboration with private-government agents to mobilize resources to enhance the country's exports and reduce the imports. The measures included specialized credit other technical supports. It helped Korea resolve problem related to financial requirements, taxation structure, agricultural productivity, fisheries development, heavy industry, mining, light industry, information, marketing, technical assistance and quality improvement. One of the major contributions of EPSC was to invite heads of major firms in the potential buyer countries. It introduced the Korean goods into the international market and developed a nexus for future. By considering all these measures, it is safe to say that the country's internal policy structure is far more important than merely relying on comparative measures such as currency devaluation, according to Haggard et al. (1991).

External donors such as IMF and World Bank recommend exchange rate devaluation as structural adjustment in order to correct macroeconomic variables. Does the devaluation strategy really work for Pakistan and the underlying macro components such as the Real Exchange Rate, Exports and Balance of Trade actually respond to the currency devaluation? Modified Marshall-Lerner Condition applied for Pakistani variables show that the devaluation have little or rather adverse impact on BoT. The lack of BoT responsiveness is because Imports volume is far greater than that of exports. Further, only one third exports are sensitive to the devaluation effect whereas whole of the imports are negatively hit by currency devaluation. When quarterly real exchange rate and disaggregate exports are analyzed (1983Q1-1993Q3) to find the devaluation impact on correction of BoT it is found that the BoT would deteriorate and also it can cause cost push inflation, as the import prices would surge (Khan, 1994).

Nam (1995) carried a study to look deeper into South Korea's export led growth and its association with exchange rate policy for the years 1962-91. It is found that Korea initially

protected its domestic markets and flourished Heavy Chemical Industry (HCI) to meet domestic needs as well as produce exportable commodities. Before 1960, Korean economy was in turmoil: budget and BoT deficits, high unemployment and surging inflation. In order to control the economic situation during this era the exchange rates was kept fixed and also highly overvalued to support the local industry establishment. In order to discriminate against unwanted imports, multiple exchange rates were in operation. Once a sound base was set, in order to lift exports Korean won was drastically devalued to 255 won per USD from 130 won a USD in 1964. Along with the exchange rate reform, exporters were incentivized to meet their export targets. This study concludes that export subsidy instead of free trade, a system of neutral incentive between imports and exports, high level of domestic investment, availability of infrastructure to support the growth are the key factors which lead to make an export led growth possible. The currency devaluation is effective only if the prerequisites are in operation.

Kamal & Dharmendra, (1997) designed a research in order to explore the effectiveness of currency devaluation on the country's trade balance in eight of the European, Latin American, Asian and African developing countries. They adopted a new methodology proposed by Wickens and Breusch to estimate the long run relation between devaluation and the trade balance. They have found that currency devaluation is not effective in improving the BoT in long run, instead it can deteriorate the condition. The research empirical findings explain that only in Mexico devaluation is found to improve BoT in long run. In Morocco Greece and Cyprus, devaluation has a negative long run effect. In Guatemala, Colombia, Thailand and Singapore long run effect of devaluation is neutral. Most of the standard theories fail to explain the circumstance under which the findings of this study can take place.

Abeysinghe & Yeok (1998) carried their study in Singapore to find the impact of Singapore Dollar appreciation on its export competitiveness during 1980-95. They find that the appreciation of Singapore Dollar had a positive impact on the export competitiveness of the country. This anomaly that contradicts with the prevailing conventional point of view is contributed to the high import contents of the exports. This means that the appreciation made the production inputs less expensive reducing the cost of production and finally

resulted in cheaper exports to the foreigners. The study concludes that if import contents of exports are high and the domestic value addition is low, then the appreciation of currency would have a positive impact on the exports of the country. However, if the domestic input is more than the imported contents, then the currency appreciation to export competitiveness relationship can be the other way around.

Rehman & Muhammad (2003) modeled a research in order to find the empirical validity of the J curve existence in Pakistan. They used aggregate data to investigate the long-run effect of real depreciation of Pak Rupee on country's BoT. They find that there exists an evidence of J curve. However, a long-run impact of real devaluation of Pak Rupee appears to be unfavorable. It is suggested that if the trade data is used at disaggregate level, the results of the model are expected to improve and give significant insights of the true impact of currency devaluation on Pakistani BoT.

Panel data Analysis for relationship between currency devaluation and output growth in 11 Asian countries for the years 1968 to 1999 suggests existence of relationship between these two variables in long run. Five of the countries under research, and for the overall panel, currency depreciation impact on output growth is found to be negative. Whereas, the Philippines, Myanmar and Indonesia currency depreciation improves output growth prospects. This study also include Pakistan for which the study show that the devaluation has a negative impact on its output growth (Christopoulos, 2004).

Keeping other variables constant, MLC needs to be satisfied for the existence of J-curve. The Marshall Lerner condition MLC implies that the local currency depreciation can improve BoT only if country's exports and imports are elastic and the total of the two elasticities is greater than one. If goods are inelastic the BoT may deteriorate rather than the improvement. In case of Pakistan, as the exports have high import contents, and most of the imports are inelastic, a J-Curve does not seem to exist. It also implies that Pakistan would not benefit from currency devaluation (Rehman, 2007).

Kanchana & Ahmed (2010) produced a research piece in which they have examined empirically the exchange rate effects on movements in trade performance between the Sri Lanka and China over the quarterly data for the years 1993-2007. The study was carried

on disaggregated as well as aggregate levels. They have shown that the devaluation of Sri Lankan rupee compared to Chinese RMB has a positive effect on Sri Lanka's exports to China whereas the same has a negative impact on Sri Lankan imports from China. The study further sheds light that the exchange rate changes matter at sectoral level trade. If the aggregate level studies are made, there are chances that significant details be lost in the overall impact of the devaluation. Therefore, a better approach is to adopt analysis at import and export sectoral bifurcation while measuring devaluation effect on a country's trade balance.

According to Shahbaz, et al. (2012), there is a long run relationship between the real exchange rate and BoT of Pakistan when analyzed for the period of 1980-2006 using quarterly data. However the coefficient of the elasticities are negative that establishes the fact there is no evidence of J-Curve existence for Pakistan. Hence the policy makers need to be vigilant while deciding on to devalue Pak Rupees, as it may worsen the BoT instead of improving it.

Rehman et al. (2012) considering evidence from previous researches and from the empirical evidence say that it is understandable that the depreciation in exchange rate of Pakistan has not been effective in improving the BoT. Instead, it increases the burden on Pakistan Economy when considered in the context of foreign debt. The foreign debt burden increase due to currency depreciation has a far greater impact than total trade volume between Pakistan & its counterparts. Hence SBP may not devalue Pak Rupees as a policy variable in order to improve the BoT.

Verheyen (2013) studied the relationship between nominal as well real exchange rate and exports of twelve European Monetary Union (EMU) countries' Exports to the USA, measured in Euros, using monthly data from 1988M1 to 2012M5. The then newly developed approach known as Non-Linear Auto-Regressive Distributed Lag Bound testing was used to find out if the EMU exports to USA respond in a linear or nonlinear fashion. The nonlinear response implies that the exports respond differently to the Euro appreciation and yet in a different magnitude to the same level of depreciation of the Euro against USD.

It is found that the EMU exports actually respond more strongly to the Euro depreciation than it does to the Euro appreciation.

Hassan (2018) performed nonlinear ARDL technique to check the existence of relationship between real bilateral exchange rates and ten industry level trade balance. The study was conducted on Pakistan and her six major trading partners including USA, China and UK, using annual bilateral trade and exchange rate data for the period of 1980-2017. The study observes the existence of nonlinear responsiveness of the exchange rate responsive industries. The study finds that the asymmetric association is between the trade balance and exchange rate is better captured using nonlinear ARDL model than the traditional linear approaches to look for a short term J-Curve pattern in the trade balance after depreciation and appreciation. However, the study finds a very week relationship between these variables and that too for a limited number of industries and countries. Therefore, the sole reliance on the exchange rate for the correction of trade balance is not recommended by this study.

Laetitia & Hongbing (2019) used time-series data for the years 1980 to 2016 to analyze and appraise the effect of local currency – CFA Franc devaluation on the Cameroon's BoT. The analysis results show that the trade and exchange rate variables of Cameroon do not satisfy the Marshal Lerner Condition (MLC). Low level of domestic substitution of imports can be one of the reasons, and also it matters that main exports of Cameroon are raw materials along with low-value-added products due to lack of industrialization of the country. As a result the country becomes price taker instead of price setter in the international market. The study finds existence of a negative correlation between RER and TB. Further it states that TB deterioration in short-run would be corrected in long-run that proves the existence of J-curve effect in case of Cameroon. Thus in Cameroon, the currency devaluation can be used as a remedy for trade deficits.

2.3. Literature related to Trade theories

2.3.1. Standard Theory of the International Trade

Trade has long existed in human societies. As far as the formal trade theories and trade systems are concerned, sixteenth through eighteenth centuries witnessed Mercantilism

being principal economic system in most of the industrial countries. This approach to foreign trade presumed that a nation's wealth depended primarily on her ability to accumulate gold and silver like precious metals. These precious metals could be accumulated by a nation through increasing her exports, debarring imports and through encouraging discovery of gold and silver in countries like United States in that era (Peukert, 2012). Mercantilism could not bring economic stability and the system failed, paving way for criticism and emergence of new theory to be recognized as Standard Theory of the International Trade (Wilson, 1959). The new theory stemmed off from "Wealth of Nations" by Adam smith in 1776 (Smith, 1776) and "On the Principles of Political Economy and Taxation" by David Ricardo in 1817 (Ricardo, 1817). These two books signaled the advent of free trade theory era that lead the remarkable and unparalleled prosperity of England in the field of trade and industry (Sen, 2010).

The new trade theory linked the flow of commodities across boarder with the changes in real exchange rate based on common sense observation. Citrus Paribas, the exchange rate movement affects the volume as well as value of the trade. If the home currency depreciates, then the domestic buyers can buy few of the foreign imported goods with the same value of money. Or putting it in other words, the domestic buyers can buy more of the domestic goods with the price of or the unit of imported goods. This implies that the nationals of the depreciating currency country buy fewer of the imported goods – leading to decreased imports, and the foreign nationals start buying more from that country – resulting in increased export volume of the subjected country. As a matter of fact the standard trade theory simplifies the balance of trade position by associating it with the real exchange rate: higher the real exchange rate (real depreciation) more the balance of trade surplus (Zhang, 2008).

The traditional trade theory is concerned with the increased volume of the exports and decreased volume of imports through real depreciation, however without focusing the impact of variation in sum total value of the exports and imports. This led to the introduction of the elasticity approach to study the exchange rate and BoT.

2.3.2. The Elasticity Approach

The real exchange rate depreciates does not always guarantee an improvement in the balance of trade (Ali, Johari, & Alias, 2014). As per Lerner (1944) the trade balance of a country does not depend on the physical goods trade volume but rather on the actual values of the international trade. Lerner stressed and furthered the standard theory by saying that the price elasticity of import demand and that of export are the key determinants in measuring the real exchange rate changes' effects on the balance of trade.

2.3.2.1. Bickerdike-Robinson-Metzler Condition:

In this approach to trade balance, the correction path is foreseen on the basis of demand elasticities for exports and imports. The term demand elasticity can be defined as percentage change in quantity of a commodity or service demanded due to a percentage changes in price (Howitt, Watson, & Adams, 1980). The Elasticity Approach to trade balance is generally known as Bickerdike-Robinson-Metzler Condition (Hooy & Chan, 2008) however in actual, Bickerdike (1920) was the originally developed and put down the elasticity approach basis through modeling nominal exports and imports prices as the functions of export and import quantities (Brooks, 1999; Chipman, 1993). Later Metzler (Metzler, 1945) and Robinson (1947) added to this approach by detailing and clarifying Bickerdike's unique idea.

Bickerdike-Robinson-Metzler Condition indicates the dependence of trade balance in terms of foreign currency on following four factors

I. Export supply
II. Import supply
III. Demand elasticities of exports and imports and
IV. The initial trade volume.

Discussion under this approach pivots on responsiveness of volume as well as the value in terms of foreign exchange to a given change in the real exchange rate. In order to better

understand, the figure 1[6] provides a summary of the two possible outcomes a country would face if it devalues its currency in case of having an *elastic domestic supply*.

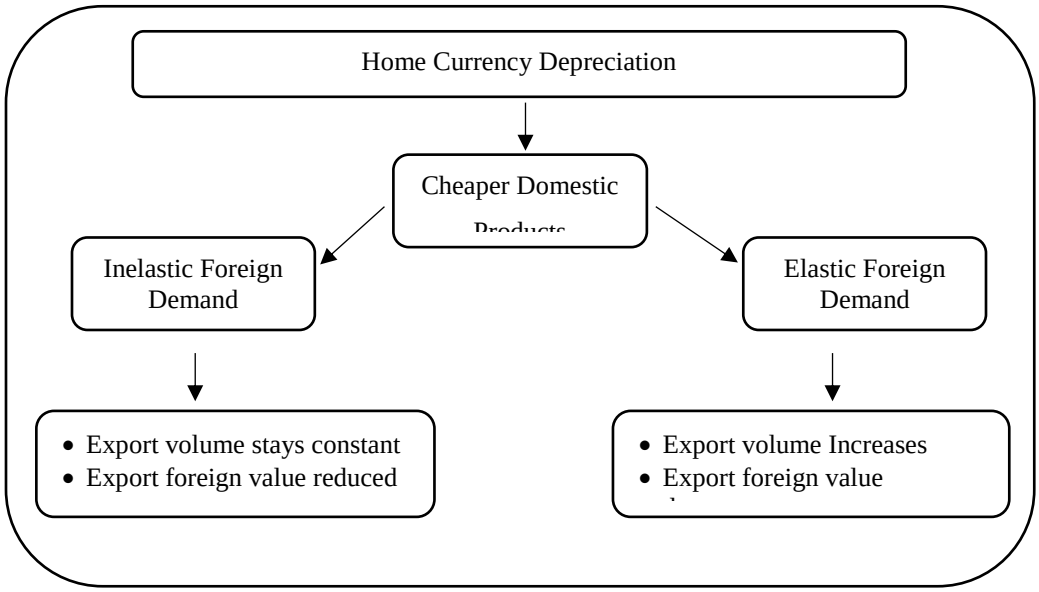

Figure 2.1: Elasticity Approach: Foreign Demand

As depicted in the figure 1, similar logic can also be applied to domestic demand. However, as depicted in Figure 1, when the home currency is depreciated foreign nations would have to pay less in order to buy one unit of the same good for which previously they were paying more. That in simple words implies the domestic goods have become cheaper. In this situation, when foreign demand is elastic or responsive to price change, more of the domestic goods would be demanded abroad. However, if the elasticity of foreign demand is not strong and sufficient to off-set the price decline by the volume increase, there would be an increase in the export volume, but the decline in the value realized in terms of foreign currency would be less than the initial value received before the depreciation. This is so because the new foreign currency per unit price of exported commodity is less than before depreciation (Marshall & Groenewegen, 1923). This implies that in order to get out of the BoT deficit, the devaluation tool may not be useful. Therefore, other measures are required to correct the situation for the BoT improvement. These measures may include, but not

[6] Adopted from Ali, D. A. et al. (2014). The Effect of Exchange Rate Movements on Trade Balance: A Chronological Theoretical Review. *Economics Research International, 2014*, 7

limited to, export promotion policy, non-price export competitiveness boost through bilateral and multilateral trade agreements.

Thinking on similar lines, the domestic demand pattern can also be comprehended. If the domestic demand for imports is elastic, while the country's home currency depreciates, the import volume would decline. It would cost more to the domestic users in terms of their native currency, even if the foreign prices are stable at the same old value. In response to higher imported good prices, the domestic consumers would switch to substitutes, resulting in reduced imports volume and reduced foreign currency value of the imports. It will result in improving the trade balance (Ali, Johari, & Alias, 2014).

It is recommended that a country can use the elasticity approach when it faces a trade balance deficit, given the country's imports and exports are elastic enough to induce sufficient reduction in imports and substantial increase in the exports. Due to the elastic nature of exports and import demand, a minor change in the exchange rate can amplify the impact on trade and hence significant trade balance impact (Daniels & VanHoose, 2005).

2.3.2.2. Marshall-Lerner Condition (MLC)

When Bickerdike-Robinson-Metzler Condition is further extended, Marshal Lerner Condition is produced. This condition can be considered as a repercussion of the Bickerdike's (Bickerdike, 1920) work. Nevertheless, this approach has been named after well-known economist Alfred Marshall (1842-1924), for he is believed to be father of elasticity concept and Aba Lerner (1944) for his subsequent exposition (Brooks, 1999).

As per this approach, if policymakers devalue the domestic currency with an intention to improve trade balance, they must make sure as a prerequisite that the country's demand for imports and that of its exports abroad are adequately elastic. MLC assumes that trade in services, Investment-income flows and the unilateral transfers all sum to be zero, as a basic condition.

As a result the trade account and current account become equivalent. Provided the above condition is satisfied then ML Condition can be defined as "when sum of absolute values of the demand elasticities of import and export must be greater than unit, the trade balance

would be better off after devaluation (Brown & Hogendorn, 2000). Contrariwise, given the sum does not exceed unit elasticity, depreciation worsens the existing trade balance (Lerner, 1944).

However, in case of Pakistan, and any other developing country these elements cannot be ignored, as they form a great chunk of our balance of trade (the services) and the current account – investment-income flows and unilateral transfers. That means the current account and the trade account of nation are not one and the same thing. Trade account forms only a sub part of the national current account. In these circumstances, the decisions made on the sole application of the MLC may not be as fruitful as they be expected.

In metamorphosis from Bickerdike's, MLC is based mainly on following three assumptions. The first assumption is trade balance initially being balanced or the sum of import and export being zero at the time of domestic currency being depreciated. Second and most important assumption of the MLC, prices must be fixed in the respective seller's domestic currencies. Thirdly, supply elasticities are infinite i.e. the sellers can produce any quantity they want to without any limit. The overall effect of the currency depreciation if the above three conditions be satisfied, can be portrayed as in Figure 2[7]. However, before considering the outcomes, it is worth considering if these conditions really meet. These conditions do not seem to hold in generally and specifically in case of Pakistan: No initial zero BoT, the exports are not quoted in domestic currency, rather in the foreign currency or the currency of the buyer and the supplies of exports do not seem to be perfectly elastic and unlimited as they may be constrained by number of factors.

[7] Adopted from Ali, D. A. et al. (2014). The Effect of Exchange Rate Movements on Trade Balance: A Chronological Theoretical Review. *Economics Research International, 2014*, 7

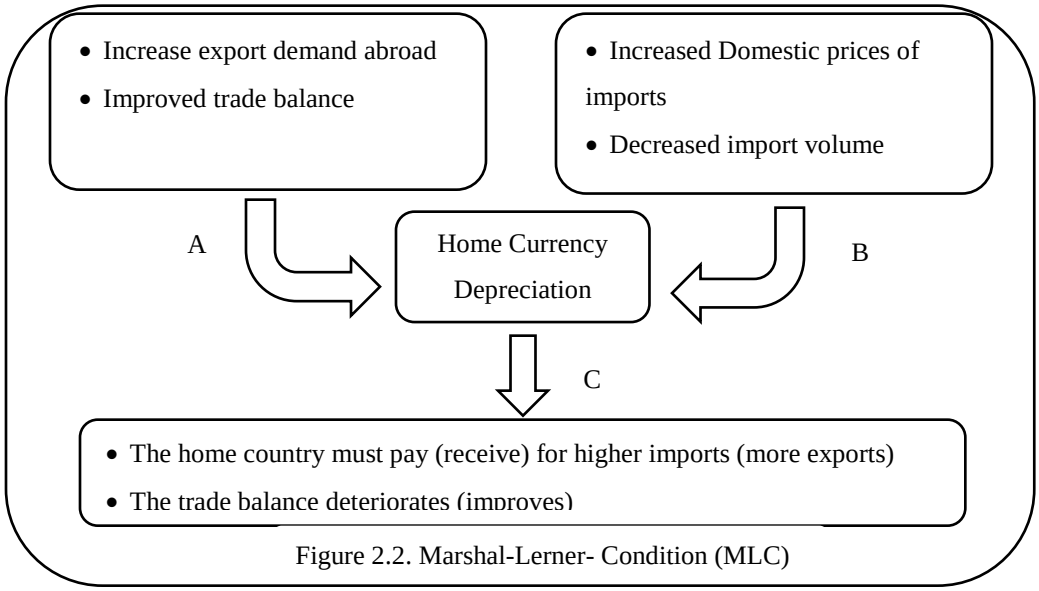

Figure 2.2. Marshal-Lerner- Condition (MLC)

Figure 2.2: Marshal-Lerner- Condition (MLC)

After currency depreciation, trade balance would improve only if the export and import volume effects shown in A and B respectively outweigh price effect represented as C. Hence, ML = (A + B) > (C) (Hacker & Abudlnasser, 2002). Further, it is also to be considered that when the export increases due to the reduced prices of the exports to the foreigners in terms of foreign currency, the domestic economy receives less per unit foreign currency price. That means if the import is reduced it is an improvement to trade balance. Nevertheless, if the export volume is not sufficient to compensate for the reduced export value, it will end up consuming the benefit harvested due to depreciation on imports front.

2.3.2.3. J-Curve Theory

There are instances when the ML Condition is met but still the trade balance failed to show any improvement after domestic currency devaluation (Bahmani-Oskooee M. , Devaluation and the J-curve: some evidence from LDCs, 1985). In order to understand and respond to such anomalies, about three decades subsequent to the generalization of the ML Condition, J-Curve theory surfaced. As first demonstrated by Magee (Magee, 1973), the J-Curve phenomenon demonstrates how the devaluation of domestic currency exchange rate would affects the country's trade balance over the time period. Therefore the j-curve can be called a dynamic version of the ML Condition (Niehans, 1984) or, in a broader perspective that of elasticity approach.

After the devaluation takes place, the imported commodities although stay at the same price level in terms of foreign currency, their domestic price in terms of local price increases and inflation is observed for these imported goods. Therefore the net exports in terms of local currency face a decline instantly and the trade balance deteriorates. The domestic users should switch to the substitutes as they have to pay more to buy the same quantity. Similarly, due to devaluation the exports of the devaluing currency should increase after the devaluation as now the foreigners have to pay less (although same in terms of domestic currency) for the same volume of the goods. However, nor the import substitution neither the enhanced export volume takes place in the short run. The reason behind is that the elasticities of the import demand and that of the export demand is objectively inelastic in short run. The delay in adjustment happen to be on import as well as on export side. This period is called the *"pass-through period"*. The domestic consumption of the imported goods does not change rapidly due to the sluggish consumer behavior and also the goods may be being sold at the old prices where the prices remain sticky (Mackintosh, Brown, & Costello, 1996) and also there may be supply bottlenecks (Gerlach, 1989). Further, the exports are not increased rapidly because of the already negotiated contracts and there may be supply bottlenecks which do not allow for boosted trade (Gerlach, 1989; Bahmani-Oskooee & Ratha, 2004)

Once the pass-through period is over, it follows the *"Quantitative Adjustment Period"*. In this period the old contracts are expired, the domestic producers start to produce cheaper substitutes to replace the expensive imported goods. Hence consumers start to switch from foreign to locally produced substitute goods in response to higher prices of imported commodities, resulting in an improved trade balance. On exports front, the domestic markets experience an improvement in exports' demand volume because of the reduced exports prices in terms of foreign currency. The domestic suppliers are also able to produce high volumes to meet the increased export demand. Overall the adjustment period has a positive impact on the trade balance (Gartner, 1993). Nonetheless, J-Curve phenomenon prophesies improved trade balance in long-run to achieve a higher level than its initial level at the time of currency devaluation (Bacchette & Gerlach, 1994). When the change in the dynamic behavior of the trade balance are traced in a graph for the period as it first deteriorates the Balance of trade (BoT) and then it elevates to a position higher than the

pre-devaluation level of the BoT, it resembles like the English letter J as illustrated in figure below[8].

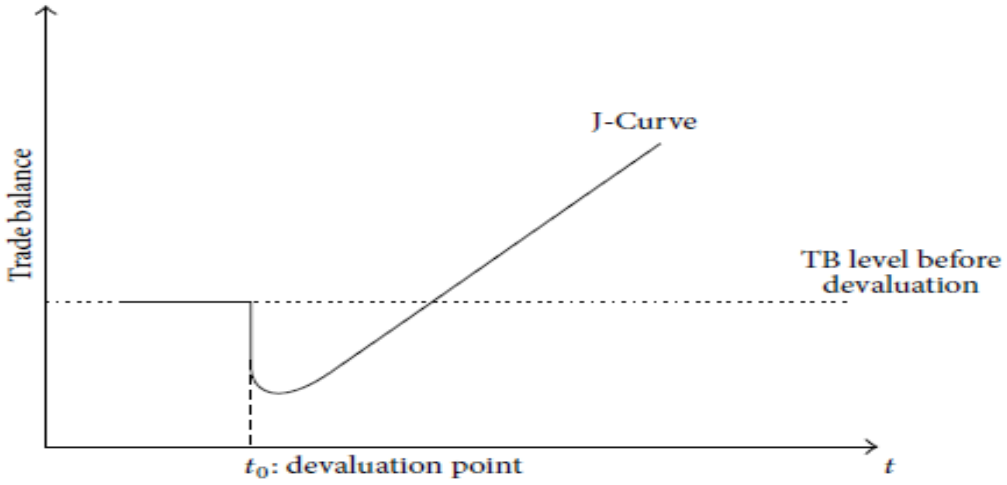

Figure 2.3: The J-Curve

In conclusion it is safe to say that the devaluation in the county's exchange rate ought to be sufficiently large so that it induces the desired change in the demand for export and import to create an improvement in the trade balance in long run. Relative to ML Condition, if and only if the trade balance progresses in long-run because of currency devaluation to higher level than it was before depreciation, under J-Curve conditions, it would be safe to say that the ML Condition has fully been satisfied (Hacker & Hatemi-J, 2004). If otherwise, the ML Condition is not met, the J-Curve will be expected to smoothen on the lower level as compared to initial position before devaluation (Sodersten & Reed, 1994).

The J-curve can be observed, once the ML Condition is met, from the period of depreciation to few months or up-to three years (Miles & Scott, 2005; Mackintosh, Brown, & Costello, 1996).

2.3.3. Keynesian Absorption Approach (KAA)

The heavily discussed elasticity approach to trade balance is criticized on the basis that it concerns only with partial equilibrium that accounts macroeconomic effect caused by price variations and production variabilities in reaction to currency depreciation (Kim, 2009). In

[8] Adopted from Ali, D. A. et al. (2014). The Effect of Exchange Rate Movements on Trade Balance: A Chronological Theoretical Review. *Economics Research International, 2014*, 7

essence, this approach only concerns with volume & value responsiveness to price variations. Conversely, the absorption and subsequent Monetary Approaches to trade balance consider depreciation as associated with macroeconomic variables which usually undermine promising influence of exchange rate depreciation on trade balance. Absorption Approach combines the Keynesian macroeconomics with the elasticities-approach. It was modeled during 1950s by Meade (1951), Alexander (1952) and others.

This approach assumes that nation's expenditures can be classified as consumption, investment, government expenditures & imports.

All of these variables are measured in the real terms because this approach considers prices as fixed. The total of these categories can also be called as the Domestic Absorption (A). At the same time, real-income (Y) of a nation is to be equal to its over-all expenditures to produce its output. Hence, real income can be expressed as sum of the consumption, investment, government expenditures and real exports. As a result, a country's current-account balance is equal to real-income (Y) less absorption (A).

In order to find the changes in current account, the country's total consumption, total investment and total government consumption needs to be subtracted from total real income of the nation.

This means that a nation's current account can only turn into surplus if the national real-income (Y) surpasses its domestic absorption (A) (Dunn & Mutti, 2000). The currency devaluation would improve national trade balance only if the country is able to produce sufficient import substitute so that the domestic consumer can opt the local products rather the expensive imported commodities i.e. the domestic output growth is higher than the absorption. This condition can only be met if the country was previously performing at a capacity less than the maximum. When there is excess capacity in a country, the devaluation would prompt higher productivity, resulting in lower imports and hence correction of trade balance would be the result (Edwards & Wilcox, 2003).

On the other hand, if the country does not have an idle capacity, the domestic output is bottlenecked in response to devaluation and hence cannot be prompted for higher

production growth. In such a condition, the absorption side of the above expression needs to be tapped. The trade balance could only be corrected if the absorption be reduced. Inflationary pressures due to devaluation also weakens the relative price changes that prompt an increased production for export and at the same time imported good consumption can be observed to be declining (Kim, 2009).

In essence, Keynesian Absorption Approach believes trade balance to be function of the real-income and the domestic absorption or domestic consumption.

$$\text{Trade Balance (TB)} = (Y, \text{A})$$

The Trade balance can improve only if there exists either an output (Y) growth or a decline in the domestic consumption or absorption (A) or be both at the same time. In case of the developing countries, when there is most of the time an excess and untapped production capacity, when the devaluation takes place, the domestic production increase. The increased production is expected to turn around the trade balance from deficit to surplus.

2.3.4. Monetary Approach (MA):

Monetary approach to trade balance is mainly campaigned by the Jacob Frenkel & Harry Johnson's work during early 1970s, almost during the same period when J-Curve theory surfaced. The MA currency devaluation understanding needs to be considered in monetary framework. Considered in the monetary setting, the deficit balance of payment (BoP) is mainly caused by excess money supply (Dunn & Mutti, 2000). Currency devaluation would cause impact on BoP only through effecting real-money supply. As a matter of fact, when devaluation takes place, the prices of imported goods in terms of domestic currency increase, it reduces the real-money supply and hence a country has an increased BoP. However, if more money is printed to tackle the inflationary pressure exerted by the imported good price hike, the benefits of the devaluation cannot be reaped and as a result previous BoP level would be re-established. Due to these factors the long-term impact of the devaluation cannot be determined with certainty (Edwards & Wilcox, 2003).

When devaluation of currency takes place in a country, the domestic currency faces a decline in its real value as more of the currency is needed to buy the same amount of goods as they were being traded previously. The phenomenon can be denoted as

$$\mathrm{N}M^{\mathrm{s}} / \mathrm{P} = M^{\mathrm{d}} (Y, \mathrm{N}E)$$

Here, $\mathrm{N}M^{\mathrm{s}}$ stands for nominal-money supply; P the general price level; M^{d} denotes money demanded; Y is the national income or output, & $\mathrm{N}E$ represents the nominal-exchange rate.

The expression explains that when the exchange rate increases when devaluation takes place that in turn increases the price which means the nation can buy less of the goods with the same amount of the money, hence the consumers reduce their spending to adjust for the loss in the real-value of held money. This would result in reduced consumption and hence the trade balance is expected to improve (Ali, Johari, & Alias, 2014).

Similarly, Johnson (1972) argued that an upsurge in supply of money would upswing real balances of money; hence, consumers foresee their wealth rising, hence there expenditures would also rise along the line of increasing money supply that means the trade balance would deteriorate rather being corrected. Hence the money supply has a negative impact of trade balance. In the similar context, Miles (1979) maintains that the inverse impact of increased supply of money may not be observable in following three situations. Firstly, nominal-money balance might be only a small component of the total wealth. Secondly, private sector might not consider money as a measure of net wealth. Thirdly, expenditures responsiveness to variations in wealth might be insignificant.

In summary, the monetary approach to trade balance implies that if the government expends supply of money after the devaluation, the gains expected due to the devaluation are undermined. Even the consumption may be increased due to enhance supply of money (Dornbusch, 1973; Frenkel & Rodriguez, 1975).

2.4. Literature Summary

There exists a huge number of studies on the subject this study is trying to look after. Number of studies have checked aggregate behavior of trade balance influenced by the

exchange rate and others have decomposed the trade balance in exports and imports and yet others did a commodity level studies. Few of the studies have used nominal exchange rate as a key regressor, whereas the real exchange rate has been used more often instead of the former. Yet, other researchers have gone further in details and used bilateral effective exchange rate to study the impact of exchange rate variation on the trade balance. Most of the studies have used linear relationship restriction on the relationship between the trade balance and exchange rate, yet, only a few have also gone to relax this restriction and then studied the phenomenon.

Considering the nature of vast literature already available, it is observed that the most of the literature has emphasized linear relationship between trade balance and exchange rate changes for example Laetitia & Hongbing (2019) and Shahbaz et al. (2012) are among many other researchers. On the other hand there are very few studies who have studied the trade balance and exchange relationship in a nonlinear assumption i.e. Hassan (2018) and Verheyen (2013) are among the few other researchers.

Further, the real exchange rate (RER) that is used in most of the studies (Kamal & Dharmendra, 1997; Shahbaz, Jalil, & Islam, 2012), however, is found to have a vague relationship with NER (Katseli, 1983). The RER is the NER times the ratio of the foreign prices to domestic prices. So when the NER changes, it is not necessary that the domestic and foreign prices change. As discussed earlier, if the exports do not have high import contents then the domestic price of the exportable are not affected. Hence the RER will have no change in its components except change in the NER. Interestingly NER is the policy variable that is adjusted by policy makers in an attempt to alter RER that would in turn have an impact on BoT. In this situation the use of NER may be a better option, as it would directly demonstrate the impact of change in NER and the related BoT.

The literature presents that the exchange rate appreciation or depreciation has an impact, positive or negative and sometimes no impact on the balance of trade of a country. There are many reasons for this, like the nature of economy, the previous state of balance of trade, the length of exchange rate stability, and the optimal exchange rate and so on. Therefore,

it is not possible to draw a rule of thumb in association of exchange rate depreciation and correction of balance of trade of a country.

As a final remark, the literature suggests a study to be conducted that compares the results of linear as well as nonlinear association between the trade balance and / or exports imports and nominal as well as real exchange rates simultaneously so that the superiority of one of the techniques and that of the exchange rate measure is established.

2.5. Hypothesis of the study

Based on the above literature review following hypothesis can be formed.

1) **H_0:** The exchange rate depreciation improves the trade balance.
   H_1: The exchange rate depreciation does not improve the trade balance.

2) **H_0:** The exchange rate depreciation appreciation has symmetric impact on trade balance.
   H_1: The exchange rate depreciation appreciation has asymmetric impact on trade balance.

Chapter 3

Methodology

3.1. Introduction

The methodology chapter of this study consists of the theoretical framework explaining the relationship among the study variables. Following the theoretical frame work is conceptual frame work that is a graphical representation of the theoretical framework. Subsequently, the economic models are discussed followed by an econometric model for this study. Following the econometric models the expected signs of the coefficients are discussed. Afterwards, the data and variable construction is explained. Finally, the chapter describes the estimation technique for this study.

3.2. Theoretical Frame Work

The fluctuation of exchange rate changes the pricing of one country's goods for the other trading partners. If other factors kept constant, in case of depreciation the exports of the country becomes cheaper for the foreign nations and at the same time the imports become expensive. Similarly, if a country's currency appreciates, then the foreign country's residents feel that that country's goods have gone expensive, however the appreciation makes the subjected country to import cheaply in terms of domestic currency.

The exchange rate policy is based in the belief that the exchange rate is a tool that can help improve national balance of payment rather than only being a measure of conversion between prices of foreign and domestic goods traded. For this purpose, the policy making body observes the fundamental difference between using nominal exchange rate (NER) as an active instrument to take care of external balance as compared to a tool that protects the domestic economy from foreign goods-market interferences. However, it is to be admitted that the use of exchange rate policy to control either of these targets depends on the structural characteristics of the economy in consideration. If the devaluation of NER mends the balance of trade (BoT) depends on: firstly if it can play a role in devaluation of the real exchange rate (RER) and secondly if it has a direct effect on domestic absorption (Katseli, 1983).

If the exports have high import contents then the currency devaluation pushes the cost of production up making the exports even more expensive. On the other hand if the import contents of the exported goods are low, than the depreciation does not have a large impact on the cost of production, as most of the value added is domestic, as a result the exportable become cheaper for international market. Thus, the application of exchange rate to stimulate BoT correction needs to be considered in the light of origin of inputs to the export commodities. That is, if you have something of your own to export, devaluation is going to help you, if you relay on imports for your exports, the devaluation may not bring the desired results, rather it may hurt the basic goals (Abeysinghe & Yeok, 1998).

These studies guide us of the channels that lead the impact of changes in exchange rate in determining fate of balance of trade and overall balance of current account for a country. The exchange rate variation casts impact on the imports and export value directly and also the exchange to imports channel also has an impact on the exports and overall the value of the export and imports determine the level of BoT.

Further, the real exchange rate (RER) that is used in most of the studies (Kamal & Dharmendra, 1997; Shahbaz, et al. 2012), however, is found to have a vague relationship with NER if studied in context of Katseli (1983). The RER is the NER times the ratio of the foreign prices to domestic prices. So when the NER changes, it is not necessary that the domestic and foreign prices change. As discussed earlier, if the exports do not have high import contents then the domestic price of the exportable are not affected. Hence the RER will have no change in its components except change in the NER. Interestingly NER is the policy variable that is adjusted by policy makers in an attempt to alter RER that would in turn have an impact on BoT. In this situation the use of NER is better option, as it would directly demonstrate the impact of change in NER and the related BoT.

The literature presents that the exchange rate appreciation or depreciation has an impact, positive or negative and sometimes no impact on the balance of trade of a country. There are many reasons for this, like the nature of economy, the previous state of balance of trade, the length of exchange rate stability the optimal exchange rate and so on. Therefore, it is

not possible to draw a rule of thumb in association of exchange rate depreciation and correction of balance of trade of a country.

3.3. Conceptual frame work

The discussion in the previous section leads to formation of following association between the variables in a visual format.

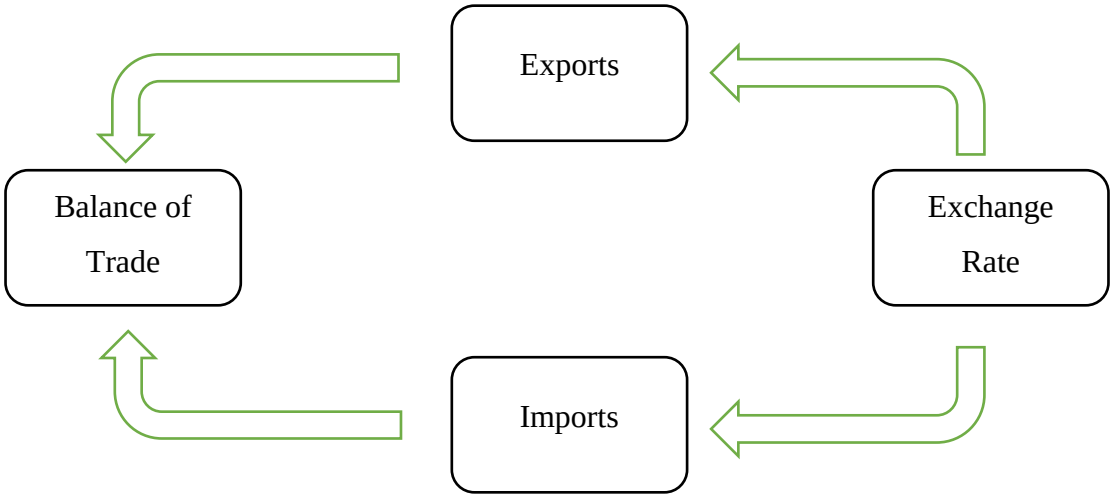

Figure 3.1: Conceptual Frame Work

The frame work shows the linkage among the exchange rate, exports, imports and ultimately trade balance.

3.4. Economic Model

Rose & Yellen (1989) framed the model for trade balance & defined trade balance to be a function of the real GDP of the domestic country facing currency devaluation, trading partner country, and the real-effective-exchange-rate (REER). This can be denoted as following term:

$$\text{Trade Balance (TB)} = f(Y, Y_f, REER) \qquad (1)$$

Ensuing Bahmani-Oskooee (1985) and Rose & Yellen (1989) the abridged bilateral commodity level model for trade balance can take the following form (Vural, 2016).

$$InTB = \alpha_0 + \alpha_1 lnY + \alpha_2 lnY_f + \alpha_3 lnREER_t \qquad (2)$$

Here, all the terms are in log form. The variables used in the equation are as follows:

TB Trade balance (Export / Imports) is a ratio of domestic exports value to that of imports

Y Home country's Gross Domestic Product

Y_f trading partner country's Gross Domestic Product

REER Real Effective Exchange Rate

Here the α_3 is the elasticity that according to ML Condition should be greater than 1 ($\alpha_3 > 1$) in absolute terms, in order to make the currency devaluation improve the country's trade balance.

Trade balance is net exports or exports less imports.

$$TB = X - M \qquad (3)$$

Where X is exports and M is the imports of home country.

However, the above function (2) uses TB as follows:

$$TB = X/M \qquad (4)$$

There are three reason behind this alteration of using trade balance as X/M rather X-M (Rehman & Muhammad, 2003).

First, the difference form of the trade balance may come in negative in case of trade deficit. That implies the log cannot be applied on the model to find the rate of change of the respective variables. Hence, the export to import ratio allows the application of log function which when first differenced gives out rate of change in the each variable.

Secondly, the measurements in ratio become unit insensitive (Bahmani-Oskooee & Alse, 1994). Nonetheless, researches in past have found that the results could have been sensitive to the units of measurements 1979, 1985 (Miles M. A., 1979; Himarios, 1985).

Thirdly, ratio measure to trade balance depicts the trade balance result in nominal or real terms, as the case may be with the values used in the model (Bahmani-Oskooee & Brooks, 1999).

In equation 2 the coefficient for REER, α_3, is sum of the import and export demand elasticities. Therefor if the individual demand elasticities of export and import are required then it can be determined as well.

Export and imports can be represented in functional form as follows (Shahzad, Nafees, & Farid, Marshall-Lerner Condition for South Asia: A Panel Study Analysis, 2017).

$$M = f(Y, ER_{iw}) \quad (5)$$

$$X = f(Y_f, ER_{iw}) \quad (6)$$

The above Import and export functions can be translated into following import and export demand in following manner.

$$LnM_t = \alpha_0 + \alpha_1 lnY_t + \alpha_2 lnER_t \quad (7)$$

$$LnX_t = \beta_0 + \beta_1 lnY_{f,t} + \beta_2 lnER_t \quad (8)$$

The above system of equations denotes that the domestic imports depend upon the domestic GDP (Y_t) and exports from the domestic country to rest of the world are dependent on the rest of the world (RoW) GDP ($Y_{f,t}$). Whereas both of these variables share a common determinant that is the exchange rate i.e. number of domestic currency units per USD.

Similar model is used by the Jamilov (2011) for Azerbaijan to test the MLC through finding import and export elasticities separately between the Azerbaijan and the European Nations. After finding the separate elasticities the α_1 and β_1, they are summed up to see if the exceed the unit (1), that is the ML Condition.

Yet again Caporale et al. (2012) have also used the same expression as in equation 7 and 8 with an addition of trend capture term to study the existence of ML Condition in the Kenyan economy.

3.5. Econometric Model

So far models discussed believe that the relationship between the exchange rate and the export import or trade balance is linear, however that may not be the situation. The long run models for the Linear ARDL methodology are

$$LnM_t = \alpha_0 + \alpha_1 lnY_t + \alpha_2 lnRER_t + \varepsilon_{t,r} \quad (9)$$

The above equation shows long run relationship of imports and the real exchange rate.

$$LnX_t = \beta_0 + \beta_1 lnY_{f,t} + \beta_2 lnRER_t + \theta_{t,r} \quad (10)$$

The above equation shows long run relationship of exports and the real exchange rate.

$$LnM_t = \alpha_0 + \alpha_1 lnY_t + \alpha_2 lnNER_t + \alpha_3 lnP_t + \varepsilon_{t,n} \quad (9.1)$$

This equation represents long run relationship of imports and the nominal exchange rate.

$$LnX_t = \beta_0 + \beta_1 lnY_{f,t} + \beta_2 lnNER_t + \alpha_3 lnP_t + \theta_{t,n} \quad (10.1)$$

This equation represents long run relationship of exports and the nominal exchange rate.

The above four models are specified to analyze long run association of real exchange rate and nominal exchange rate with exports and imports. To analyze short run effects of nominal and real exchange rate on export and imports, the error correction models for each long run model is as follows

$$\Delta lnM_t = \alpha + \sum_{k=1}^{l} \beta_k \Delta lnM_{t-k} + \sum_{k=0}^{l} \gamma_k \Delta lnY_{t-k} + \sum_{k=0}^{l} \delta_k \Delta lnRER_{t-k} + \varepsilon_{k0} \mathrm{ECT}_{t-1} + \mu_{t,m,r} \quad (9.2)$$

The equation 9.2 represents the linear ARDL error correction model for the imports and real exchange rate.

$$\Delta lnX_t = \rho + \sum_{k=1}^{l} \sigma_k \Delta lnX_{t-k} + \sum_{k=0}^{l} \tau_k \Delta lnY_{f,t-k} + \sum_{k=0}^{l} \varphi_k \Delta lnRER_{t-k} + \theta_{k0} \mathrm{ECT}_{t-1} + \mu_{t,x,r} \quad (10.2)$$

The equation 10.2 represents the linear ARDL error correction model for the exports and real exchange rate.

$$\Delta lnM_t = \alpha + \sum_{k=1}^{l} \beta_k \Delta lnM_{t-k} + \sum_{k=0}^{l} \gamma_k \Delta lnY_{t-k} + \sum_{k=0}^{l} \delta_k \Delta lnNER_{t-k} + \sum_{k=1}^{l} \pi_k \Delta lnP_{t-k} + \varepsilon_{k1} \mathrm{ECT}_{t-1} + \mu_{t,m,n} \quad (9.3)$$

The equation 9.3 represents the linear ARDL error correction model for the imports and nominal exchange rate.

$$\Delta lnX_t = \rho + \sum_{k=1}^{l} \sigma_k \Delta lnX_{t-k} + \sum_{k=0}^{l} \tau_k \Delta lnY_{f,t-k} + \sum_{k=0}^{l} \varphi_k \Delta lnNER_{t-k} + \sum_{k=1}^{l} \varphi_{k,1} \Delta lnP_{t-k} + \theta_{k1} \mathrm{ECT}_{t-1} + \mu_{t,x,n} \quad (10.3)$$

The equation 10.3 represents the linear ARDL error correction model for the exports and nominal exchange rate.

The linearity assumption may be too restrictive (Verheyen, 2013). In order to study the impact of nonlinearity, the above models need to be applied by nonlinear ARDL framework recommended by Shin et al. (2011) that splits the exchange rate changes into

depreciation and appreciations. When the exchange rate is measured as domestic currency per unit foreign currency, the appreciation is when the exchange rate decreases whereas it is depreciation when the exchange rate increases. If appreciation is denoted by R^- and depreciation by R^+, then $R_t = R_0 + R^+ + R^-$.

As a result, the above economic models are transformed into the following long run econometric models.

$$LnM_t = \alpha_0 + \alpha_1 lnY_t + \alpha_2 lnRER_t^+ + \alpha_3 lnRER_t^- + \varepsilon_t \quad (9.4)$$

The above equation is specification Nonlinear ARDL for imports and Real Exchange Rate.

$$LnX_t = \beta_0 + \beta_1 lnY_{f,t} + \beta_2 lnRER_t^+ + \beta_3 lnRER_t^- + \varepsilon_t \quad (10.4)$$

The above equation is specification Nonlinear ARDL for imports and Real Exchange Rate.

The above models (9.4 & 10.4) will provide the long run estimates for nonlinear ARDL model based on real exchange rate appreciation and depreciation. Furthermore, the error correction mechanisms for the above nonlinear ARDL models are as follows.

$$\Delta lnM_t = \alpha + \sum_{k=1}^{l} \beta_k \Delta lnM_{t-k} + \sum_{k=0}^{l} \gamma_k \Delta lnY_{t-k} + \sum_{k=0}^{l} \delta_k \Delta lnRER_{t-k}^+ + \sum_{k=0}^{l} \theta_t \Delta lnRER_{t-k}^- + \varepsilon_{k2} ECT_{t-1} + \mu_{t,m,r,nl} \quad (9.5)$$

The equation 9.5 is used to estimate the Nonlinear ARDL Error Correction Model for the imports and real exchange rate.

$$\Delta lnX_t = \rho + \sum_{k=1}^{l} \sigma_k \Delta lnX_{t-k} + \sum_{k=0}^{l} \tau_k \Delta lnY_{f,t-k} + \sum_{k=0}^{l} \varphi_k \Delta lnRER_{t-k}^+ + \sum_{k=0}^{l} \omega_k \Delta lnRER_{t-k}^- + \theta_{k2} ECT_{t-1} + \mu_{t,x,r,nl} \quad (10.5)$$

The equation 10.5 is used to estimate the Nonlinear ARDL Error Correction Model for the exports and real exchange rate.

As Katseli (1983) had concerns over the transmission of nominal exchange rate into the prices and subsequently the real exchange rate, the above models can be split into real exchange rate models, after splitting the real exchange rate into Nominal exchange rate and relative price where relative price is a ratio of foreign price to domestic price.

$$LnM_t = \alpha_0 + \alpha_1 lnY_t + \alpha_2 lnNER_t^+ + \alpha_3 lnNER_t^- + \alpha_4 lnP + \varepsilon_t \quad (9.6)$$

Equation 9.6 represents the general nonlinear ARDL ECM model for imports and Nominal exchange rate.

$$LnX_t = \beta_0 + \beta_1 lnY_{f,t} + \beta_2 lnNER_t^+ + \beta_3 lnNER_t^- + \beta_4 lnP + \varepsilon_t \quad (10.6)$$

Equation 10.6 represents the general nonlinear ARDL ECM model for imports and Nominal exchange rate.

The above equations also represent the long run estimates of nonlinear ARDL models based on nominal exchange rate appreciation and depreciation. To get short run results, the error correction model for above equations are as follows

$$\Delta lnM_t = \alpha + \sum_{k=1}^{l} \beta_k \Delta lnM_{t-k} + \sum_{k=0}^{l} \gamma_k \Delta lnY_{t-k} + \sum_{k=0}^{l} \delta_k \Delta lnNER_{t-k}^+ + \sum_{k=0}^{l} \theta_t \Delta lnNER_{t-k}^- + \sum_{k=1}^{l} \pi_k \Delta lnP_{t-k} + \varepsilon_{k3} ECT_{t-1} + \mu_t \quad (9.7)$$

The Equation 9.7 is to be estimated for the Nonlinear ARDL ECM for imports and Nominal Exchange rate.

$$\Delta lnX_t = \rho + \sum_{k=1}^{l} \sigma_k \Delta lnX_{t-k} + \sum_{k=0}^{l} \tau_k \Delta lnY_{f,t-k} + \sum_{k=0}^{l} \varphi_k \Delta lnNER_{t-k}^+ + \sum_{k=0}^{l} \omega_t \Delta lnNER_{t-k}^- + \sum_{k=1}^{l} \pi_{k1} \Delta lnP_{t-k} + \theta_{k3} ECT\varepsilon_{t-1} + \mu_t \quad (10.7)$$

The Equation 10.7 is to be estimated for the Nonlinear ARDL ECM for exports and Nominal Exchange rate.

3.6. Expected Signs of the coefficients

Assuming that the supplies are infinitely elastic for export and import (Brook, 1999) which is a basis of the MLC, following can be inferred regarding the coefficients signs in model 9 and 10.

With the increasing GDP (income) the country's imports are expected to grow. On similar note, when the foreign GDP (income) increases the demand for domestic exports to the foreign country would grow. Therefore, the income elasticities i.e. α_1 and β_1 are expected to have positive signs in the model. On the other hand, when domestic currency depreciates,

the domestic goods (exports) become cheaper for foreign national resulting in greater exports, whereas the imported goods become expensive for the nationals of devaluating currency therefore exerting negative impact on imports. Hence, the α_2 demand elasticity for imports or the coefficient for exchange rate in case of imports is expected to be negative (–) and β_2 the demand elasticity for exports needs to be positive (+) to make a positive impact on the trade balance (Shahzad et al., 2017). On similar grounds α_3 would be positive (+) and β_3 is expected to be negative (–) and the α_4 should be negative (–) and β_4 should be positive (+).

3.7. Data and Variable construction

This study uses monthly data from 2003M7 (data is being maintained since July 2003) through 2019M12 obtained from State Bank of Pakistan (SBP), Pakistan Bureau of Statistics (PBS) and International Financial Statistics (IFS).

The historic determination of Pakistani foreign exchange rate has been strongly linked to the United States Dollar (USD), and it still continues to be so. Therefore, it is safe to use PKR-USD exchange rate as a measure of overall Pakistani exchange rate bench mark for this study.

Further, the United States of America is being used as proxy for rest of the world statistics.

The variables are used in the nominal as well as real and log forms. The variables used in the study are described in the table 3.1 for ease and simplicity.

Table 3.1: Variables Details

Variable	**Symbolic Sign**	**Measures**	**Data Source**
Exports	X_i	Export group	SBP Statistics
Imports	M_i	Imports Group	SBP Statistics
Industrial Production Pakistan	Y	Proxy for monthly Gross Domestic Product	IFS

Industrial Production USA	Y_f	Proxy for monthly World Gross Domestic Product	IFS
Relative Price	P	Foreign to domestic Price Ratio	IFS
Foreign Prices	FP	USA Consumer Price Index (U-CPI)	IFS
Domestic Prices	DP	Pakistan Consumer Price Index (P-CPI)	IFS
Nominal Exchange Rate	NER	PKR per USD. Nominal / Weighted average Monthly exchange rate	SBP Statistics
Real Exchange Rate	RER	NER x ((FP / DP)	SBP Statistics and IFS

Export and Import Categories (Xi & Mi) are mentioned in the table 3.2 as follows.

Table 3.2: Export and Import Categories

Group	Imports (M_i)	Exports (X_i)
A	Food (MFO)	Food (XFO)
B	Machinery (MMG)	Textile (XTX)
C	Transport (MTG)	Petroleum (XPT)
D	Petroleum (MPT)	Other Manufacture (XOM)
E	Textile (MTX)	All Others (XAO)
F	Agri. & Other Chemical (MCG)	
G	Metal (MMT)	
H	Miscellaneous (MMI)	
I	All Others (MAO)	
J	Total Imports Payments Through Banks (MGT)	Total Export Receipts through Banks (XGT)

These categories are analyzed individually to find out which of these groups of imports & export are exchange rate sensitive to the extent that they make a positive impact on the trade balance.

3.8. Estimation Technique

Based on the Shin et al. (2011) framework, this study is to use Nonlinear Auto-Regressive Distributed Lag (NARDL) econometric technique to study the linear as well as nonlinear behavior of the exports and imports influenced by exchange rate of Pakistan. For the sake of comparison, the study also uses Auto-Regressive Distributed Lag (ARDL). These techniques are also sued by the Verheyen (2013) to study the impact of exchange rate on the European exports to USA.

Chapter 4

Estimation Results and interpretation

4.1. Introduction

This section deals with the model estimation and result interpretations of this study.
This study makes estimations using ARDL and Nonlinear ARDL model. These models are applicable if the variables are integrated of order zero or order 1 i.e. I (0) 0r I (1) and there is no unit root of order 2. In order to check if the variables are stationary at level or at first difference, augmented Dickey–Fuller test (ADF) is used and the results are as follows.

4.2. Augmented Dickey–Fuller (ADF) test:

The ADF is applied on the Import, export and independent variables and the output is given in the separate tables.
Following is the ADF test result table for the import variables.

Table 4.1: ADF test on Import Variables

Variables	Level	First Difference	Remarks
lnMAO	-1.72 [0.42]	-11.41*** [0.00]	**I (1)**
lnMCG	-2.53 [0.11]	-15.76*** [0.00]	**I (1)**
lnMFO	-2.04 [0.27]	-11.05*** [0.00]	**I (1)**
lnMGT	-2.99** [0.04]	-19.63 [0.00]	**I (0)**
lnMMG	-2.79 [0.06]	-16.82*** [0.00]	**I (1)**
lnMMI	-2.69 [0.08]	-21.55*** [0.00]	**I (1)**
lnMMT	-2.73 [0.07]	-13.96*** [0.00]	**I (1)**
lnMPT	-3.41** [0.01]	-20.96 [0.00]	**I (0)**
lnMTG	-2.39 [0.15]	-15.09*** [0.00]	**I (1)**
lnMTX	-3.07** [0.03]	-9.656 [0.00]	**I (0)**
*** significant at 10%: ** significant at 5%: *** significant at 1% [P-Values]**			

The above results show that all of the import categories are non-stationary or are I (1) as per the ADF test except the MGT, MPT and MTX. However, these were also non-stationary as per the graphic demonstration. The Zivot-Andrews Test performed after ADF and is also given subsequently, conforms these variables to be I (1) as well. These results make the import categories to be suitable time series for the ARDL and NARDL analysis as recommended by Pesaran et al. (2001).

Following tables shows the ADF results of the export data set variables.

Table 4.2: ADF test on Export Variables

Variables	Level	First Difference	Remarks
lnXAO	-2.17 [0.22]	-17.48*** [0.00]	**I (1)**
lnXFO	-2.28 [0.18]	-5.29*** [0.00]	**I (1)**
lnXGT	-2.08 [0.25]	-3.84*** [0.00]	**I (1)**
lnXOM	-2.14 [0.23]	-3.98*** [0.00]	**I (1)**
lnXPT	-4.27*** [0.00]	-17.63 [0.00]	**I (0)**
lnXTX	-1.84 [0.36]	-23.18*** [0.00]	**I (1)**
*** significant at 10%: ** significant at 5%: *** significant at 1% [P-Values]**			

The ADF results stated above show that only export of Petroleum (XPT) is integrated of order 0 or it is the only variable being I (0) and all the other variables are I (1). However, these was also non-stationary as per the graphic demonstration. The Zivot-Andrews Test that performed after ADF and is also given subsequently, conforms these variables to be I (1) as well. These results make the import categories to be suitable time series for the ARDL and NARDL analysis as recommended by Pesaran et al. (2001).

Finally, following tables represents the ADF output of the independent variables.

Table 4.3: ADF test on Independent Variables

Variables	Level	First Difference	Remarks
lnNER	-0.88 [1.00]	-10.65*** [0.00]	**I (1)**
lnRER	-1.52 [0.52]	-10.69*** [0.00]	**I (1)**
lnP	-1.39 [0.58]	-5.89*** [0.00]	**I (1)**
lnY	-2.62 [0.09]	-5.12*** [0.00]	**I (1)**
lnYF	-2.69 [0.08]	-2.82* [0.06]	**I (1)**
*** significant at 10%: ** significant at 5%: *** significant at 1% [P-Values]**			

The above table shows that the independent variables are all I (1). These again satisfy the preliminary stationarity conditions of the ARDL and ARDL as recommended by Pesaran et al. (2001) for ARDL bound testing.

4.3. Zivot & Andrews unit root test with structural break:

While making visual inspection of the data series, there appeared to be some structural break(s). In order to conform if there really were structural break in the series, Zivot & Andrews (1992) unit root test with structural break was applied. Following are the results of the Zivot – Andrews test results.

Zivot – Andrew Unit root test on the variables of import category series.

Table 4.4: Zivot-Andrews (Z-A) Unit Root test on Import Variables

Variables	**T-Statistics**	**Break Point**
lnMAO	-8.09***	2008M11
lnMCG	-5.30***	2008M10
lnMFO	-6.45*	2008M11
lnMGT	-3.85	2006M5
lnMMG	-3.94**	2009M01
lnMMI	-4.75**	2017M03
lnMMT	-4.85	2006M04
lnMPT	-4.23	2008M01
lnMTG	-5.16***	2017M03
lnMTX	-6.83	2011M03
*** significant at 10%: ** significant at 5%: *** significant at 1%**		

Zivot – Andrew Unit root test on the variables of export category series.

Table 4.5: Zivot-Andrews (Z-A) Unit Root test on Export Variables

Variables	**T-Statistics**	**Break Point**
lnXAO	-5.23***	2009M07
lnXFO	-8.37	2011M08
lnXGT	-6.04***	2010M11
lnXOM	-5.87***	2011M03
lnXPT	-4.36	2010M03
lnXTX	-5.58***	2010M10
*** significant at 10%: ** significant at 5%: *** significant at 1%**		

Zivot – Andrew Unit root test on the variables of independent series.

Table 4.6: Zivot-Andrews (Z-A) Unit Root test on Independent Variables

Variables	**T-Statistics**	**Break Point**
lnNER	-2.84*	2008M03
lnRER	-3.52	2017M03
lnP	-4.37***	2008M03
lnY	-7.45***	2008M07
lnYF	-4.95***	2008M09
*** significant at 10%: ** significant at 5%: *** significant at 1%**		

Most of the variables in all three categories are having a structural break. However, the Global financial crisis or GFC 2007-8 is most prominent. Therefore, to capture the impact of the GFC 2007-8 a dummy variable has been introduced in the ARDL and NARDL analysis as fixed independent variable.

4.4. ARDL Bound Testing:

As recommended by Pesaran et al. (2001) ARDL bound test can be run and a long run relation can be established through bound ARDL bound testing given that the variables are I(0) and or I(1).

Further the ARDL is also tested for if there exists an asymmetry in the effect of exchange rate as suggested by Shin et al. (2011). In this approach, the exchange rate is split in the partial sum of the Pak rupee appreciations (ER_POS) and that of depreciation (ER_NEG). Also, Wald linear restriction test is used to test the hypothesis of ER_POS and ER_NEG being equal, in which case there will not be an asymmetry of the exchange rate impact. So if the null hypothesis of the Wald test i.e. the linear restriction of ER_POS being equal to ER_NEG is rejected, there would be an asymmetry, otherwise there will be a symmetry. If there is an asymmetry that means the appreciation and depreciation of the exchange rate impact the variable differently and not the same way.

Table 4.7: Bound Testing Imports

		Nominal Exchange Rate		**Real Exchange Rate**	
Imports	**Critical Values / Bounds (5%)**	**ARDL**	**NARDL**	**ARDL**	**NARDL**
lnMAO	**F-Statistic**	34.24	27.15	49.48	39.96
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnMCG	**F-Statistic**	9.27	6.82	5.38	6.35
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnMFO	**F-Statistic**	19.62	14.87	25.02	19.18
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnMGT	**F-Statistic**	12.21	11.32	14.57	11.34
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnMMG	**F-Statistic**	4.51	5.95	5.99	3.34
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35

Table 4.7: Bound Testing Imports Cont…

		Nominal Exchange Rate		Real Exchange Rate	
Imports	**Critical Values / Bounds (5%)**	**ARDL**	**NARDL**	**ARDL**	**NARDL**
lnMMI	**F-Statistic**	7.91	6.37	12.01	8.84
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnMMT	**F-Statistic**	9.77	8.88	12.55	9.47
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnMPT	**F-Statistic**	3.94	7.24	5.49	3.91
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnMTG	**F-Statistic**	5.32	4.83	9.05	7.06
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnMTX	**F-Statistic**	10.01	8.33	5.19	11.73
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35

The ARDL Bound results for the export related variables is as follows.

Table 4.8: Bound Testing Exports

		Nominal Exchange Rate		Real Exchange Rate	
Exports	**Critical Values / Bounds**	**ARDL**	**NARDL**	**ARDL**	**NARDL**
lnXAO	**F-Statistic**	6.37	8.16	8.37	6.27
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnXFO	**F-Statistic**	6.73	5.46	8.76	6.70
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnXGT	**F-Statistic**	9.77	8.64	5.78	4.51
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnXOM	**F-Statistic**	7.58	12.87	10.56	12.92
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnXPT	**F-Statistic**	5.47	4.55	7.19	5.35
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35
lnXTX	**F-Statistic**	5.33	4.32	5.63	4.97
	K	3	4	2	3
	I (0)	3.23	2.86	3.79	3.23
	I (1)	4.35	4.01	4.85	4.35

Based on the above ARDL bound test results, following summary table can be obtained. This shows the variables which have a long run relationship established by the bound test cointegration test.

Table 4.9: Bound Testing Imports Cointegration and long-run relationship

	Nominal Exchange Rate		**Real Exchange Rate**	
Imports	**ARDL**	**NARDL**	**ARDL**	**NARDL**
lnMAO	Yes	Yes	Yes	Yes
lnMCG	Yes	Yes	Yes	Yes
lnMFO	Yes	Yes	Yes	Yes
lnMGT	Yes	Yes	Yes	Yes
lnMMG	Yes	Yes	Yes	Inconclusive
lnMMI	Yes	Yes	Yes	Yes
lnMMT	Yes	Yes	Yes	Yes
lnMPT	Inconclusive	Yes	Yes	Inconclusive
lnMTG	Yes	Yes	Yes	Yes
lnMTX	Yes	Yes	Yes	Yes

This table shows that all the Import categories have a long-run relationship established through the existence of cointegration ARDL bound test except for the Machinery Group (MMG) and Petroleum Group (MPT). The results for these two variables are inconclusive and need further testing, that is beyond the scope of this study. As a result these two variables are only tested for short run ARDL and NARDL and rest of the variables are tested for short run as well as long run ARDL and NARDL.

The ARDL bound testing summary of the export variables is as follows.

Table 4.10: Bound Testing Exports Cointegration

	Nominal Exchange Rate		**Real Exchange Rate**	
Exports	**ARDL**	**NARDL**	**ARDL**	**NARDL**
lnXAO	Yes	Yes	Yes	Yes
lnXFO	Yes	Yes	Yes	Yes
lnXGT	Yes	Yes	Yes	Yes
lnXOM	Yes	Yes	Yes	Yes
lnXPT	Yes	Yes	Yes	Yes
lnXTX	Yes	Yes	Yes	Yes

The ARDL cointegration output for the export variables shows that the ARDL and NARDL models run using these variables have a short run as well as long run relationship.

The models where cointegration is established do have an Error Correction Mechanism (ECM) or cointegration term that determines the speed of adjustment to absorb the shock in the system to return to long run equilibrium.

After determining the possibility of the ARDL cointegration, following results of ARDL and NARDL are obtained for import and export variables.

4.5. Autoregressive Distributed Lag: ARDL and NARDL

The ARDL tests are conducted commodity wise and are given on the following pages.

A. Imports Analysis. In first part, the RADL related to imports are discussed.

1. Import – Food Group (MFO): The below table shows the estimation for the import of food category goods into Pakistan. The estimations are made using ARDL technique that has further been sub grouped into estimations using Nominal Exchange rate and Real exchange rate for the Linear ARDL and also for the Non-linear ARDL.

Table 4.11: Food Group (M = MFO)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	1,2,1,2	1,2,3,0,1	1,4,0	1,4,0,0
Lags	3	3	4	4
ΔlnY_t	0.60** (2.31)	0.72*** (2.73)	0.64** (2.43)	0.69*** (2.61)
ΔlnY_{t-1}	-0.61** (-2.38)	-0.58** (-2.25)	-0.34 (0.-1.05)	-0.35 (-1.11)
ΔlnY_{t-2}	-	-	-0.03 (-0.10)	-0.056 (-0.17)
ΔlnY_{t-3}	-	-	-0.45* (-1.71)	-0.50* (-1.89)
ΔlnP_t	-3.54** (-2.40)	-4.44*** (-2.97)	-	-
ΔlnP_{t-1}	-	3.16 (1.58)	-	-
ΔlnP_{t-2}	-	-3.16** (-2.13)	-	-
$\Delta lnER_t$	0.36 (0.42)	-	-0.58*** (-2.87)	-
$\Delta lnER_{t-1}$	1.51 (1.63)	-	-	-
$\Delta lnER\_POS_t$	-	-0.68*** (-3.14)	-	-0.66*** (-3.10)
$\Delta lnER\_NEG_t$	-	4.02* (1.92)	-	-0.51** (-2.40)
$\Delta D8$	0.14** (2.08)	0.11 (1.45)	0.17*** (3.46)	0.20*** (3.64)

Table 4.11: Food Group (M = MFO) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	0.96*** (3.43)	1.05*** (3.58)	1.15*** (5.64)	1.45*** (4.53)
lnP_t	-1.60*** (-3.83)	-1.44*** (-3.29)	-	-
$lnER_t$	-1.61*** (-3.99)	-	-1.01*** (-2.97)	-
$lnER\_POS_t$	-	-1.20*** (-3.24)	-	-1.13*** (-3.21)
$lnER\_NEG_t$	-	-0.88 (-0.94)	-	-0.87** (-2.46)
D8	0.24** (2.21)	0.20 (0.14)	0.30*** (3.91)	0.34*** (4.08)
Constant	15.07*** (6.19)	8.05*** (5.85)	11.52*** (5.62)	5.51*** (3.90)
	Panel C: Diagnostic Tests			
LM-1 lag	0.52 [0.47]	1.33 [0.25]	0.03 [0.87]	0.01 [0.92]
LM-12 lag	15.22 [0.23]	20.86 [0.05]	13.94 [0.30]	13.35 [0.34]
ARCH-1 lag	6.54 [0.01]	1.59 [0.21]	6.2 [0.01]	6.63 [0.01]
ARCH-12 lag	32.05 [0.00]	39.99 [0.00]	29.11 [0.00]	32.68 [0.00]
Jarque Bera	2.44 [0.30]	3.62 [0.16]	3.56 [0.17]	1.48 [0.48]
ECM (-1)	0.57*** (-8.76)	-0.56*** (-8.58)	-0.58*** [-8.65]	-0.58*** (-8.72)
Wald	-	5.17 {1,178} [0.02]	-	1.43 {1,180} [0.23]
CS (CS-SQ)	S(US)	S(US)	US(US)	S(US)
RESET	0.88 {1,180} [0.34]	0.11 {1,177} [0.74]	0.91 {1,180} [0.34]	0.13 {1,179} [0.72]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

The results of the nominal exchange rate for linear ARDL or simply ARDL, do not support the short term impact of the exchange rate on the import of food items as the first difference and the lagged difference coefficients are insignificant. At the same time the industrial production of Pakistan represented by Y_t have mixed results in short term as initially the increased income has a positive impact but later on it becomes negative. Contrarily, the relative price has a clear significant negative short run impact on the import of food. If there is a one percent increase in the relative price of the food import, the import would decline by 3.54%. Further the impact of the global financial crisis 2007-8 captured by D8 dummy is also significant in the short run.

As the bound test conforms the existence of long run relation, all the long run coefficients are significant. The exchange rate has a negative significant impact on the import of food items. In the long run, if there is 1 percent depreciation of the Pak rupee with respect to

USD, there would be 1.61% reduction in the import of food items into Pakistan. Relative price also has a significant negative impact on the food import, however, the Y has a positive significant impact. The long run estimates also have a significant D8 dummy variable, implying that for the given time period, the GFC 2007-8 made a long term impact. The diagnostic tests in the panel C of the above table show that the ECM has a significant negative coefficient, implying if there comes a shock in the system, the long run coefficients would return to the equilibrium with a speed of 0.57% a month. Langrage Multiplier Test (LM) with lag 1 and 12 is also significant implying the series to be free of serial correlation. The series however suffers from Autoregressive Conditional Heteroscedasticity (ARCH) at lag 1 and 12. Jarque Bera (JB) test results show that the series is normally distributed. CUSUM is stable (S) whereas CUSUM of Squares is unstable (US). The Ramsey Regression Equation Specification Error Test or RESET shows that the model does not suffer from linear specification biasness.

The results of the nominal exchange rate for non-linear ARDL or NARDL, support the short term impact of the exchange rate on the import of food items. The coefficients of the ER_POS i.e. Pak Rupee depreciation is negative and significant, that means if there is 1% depreciation of PKR there would be an increase of 0.68% decrease of food import. On the other hand, if PKR appreciates by 1%, the import of food items would face an increase of 4.02% as suggested by the ER_NEG coefficient. These two results are also supported by the Wald test applied and showing that there exists an asymmetric behavior of the exchange rate impact on the food import. Again, the industrial production of Pakistan have mixed results in short term as the coefficients being positive as well as negatively significant at different lags. The relative price has a clear significant negative short run impact on the import of food.

In the long run all coefficients are significant except the ER_NEG. The ER_POS or exchange rate depreciation has a negative significant impact on the import of food items. In the long run, if there is 1 percent depreciation of the Pak rupee with respect to USD, there would be 1.20% reduction in the import of food items into Pakistan. Relative price also has a significant negative impact whereas the Y has a positive significant impact.

The diagnostic tests show that the ECM has a significant negative coefficient, implying the long run coefficients would converge to the equilibrium with a speed of 0.0.56% a month. LM test with lag 1 and 12 is also significant implying the series to be free of serial correlation. The series however suffers from Autoregressive Conditional Heteroscedasticity (ARCH) at lag 12 but not at lag 1. Jarque Bera (JB) test results show that the series is normally distributed. CUSUM is stable (S) whereas CUSUM of Squares is unstable (US). The Ramsey Regression Equation Specification Error Test or RESET shows that the model does not suffer from linear specification biasness.

The impact of real exchange rate changes on the food item import in Pakistan is somewhat similar to that of the impact of the nominal exchange rate.

The real exchange rate (RER) has a coefficient of -0.5812 being negatively significant in ARDL as well as NARDL as being -0.6551 for ER_POS and -0.5072 for ER_NEG. In the ARDL the result can be conclusive in short run, however the NARDL results of the ER are mixed as both the appreciation and depreciation have a negative impact on the import of food items into Pakistan. Similarly, the industrial production of Pakistan Y_t also shows a mixed result in short run. The GFC2007-8 dummy D8 is positively significant in this case too.

In the long run ARDL model the RER has a negative significant coefficient of -1.01 whereas that of NARDL the ER_POS and ER_NEG have negatively significant coefficients of -1.12 and -0.873 respectively. Implying that any change in the PKR would decrease the food import, as per the NARDL, and according to ARDL results the depreciation decreases the food import into Pakistan. In the RER ARDL and NARDL, the D8 is also positively significant in the long run.

Looking at the diagnostic tests, both the ARDL and NARDL models do not suffer from serial correlation at 1 and 12^{th} lags, however there exists an ARCH effect. The Jarque Bera (JB) test shows that the series are normally distributed. The ECM is also negatively significant in both the cases ARDL being -0.5754 and NARDL as -0.5810 implying convergence to the long run equilibrium at the speed of 0.5754 and 0.5810 respectively. The Wald test of the ARDL shows that there is a symmetry in the RER_ARDL, hence the

appreciation and depreciation of the exchange rate makes the import of food items in Pakistan in the same direction. The CUSUM and CUSUM Squares are unstable RER_ARDL, however the CUSUM is stable and the CUSUM Squares is unstable in RER_NARDL. According to RESET test the models do not suffer from linear specification biasness.

In the summary, the exchange rate has an overall negative impact on the food item import in Pakistan, whether measured through nominal or real exchange rate or linear or nonlinear ARDL.

2. Import – Machinery Group (MMG)

The following table and subsequent analysis is about the import of machinery into Pakistan from all around the world as a whole. First table has the short run estimation and the second table presents the long run and the model diagnostic test results.

Table 4.12: Machinery Group (M = MMG**)**

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	5,2,0,0	3,2,3,0,0	5,2,0	6,0,0,0
Lags	5	3	5	6
$\Delta lnM_{i,t-1}$	-0.42*** (-4.88)	-0.34*** (-4.24)	-0.43*** (-5.09)	-0.60*** (-8.19)
$\Delta lnM_{i,t-2}$	-0.35*** (-3.91)	-0.24*** (-3.58)	-0.35*** (-4.04)	-0.45*** (-5.40)
$\Delta lnM_{i,t-3}$	-0.09 (-1.07)	-	-0.10 (-1.13)	-0.22** (-2.42)
$\Delta lnM_{i,t-4}$	-0.19*** (-1.07)	-	-0.19*** (-2.72)	-0.31*** (-3.68)
ΔlnY_t	0.53** (2.60)	0.64*** (3.20)	0.52** (2.60)	0.33* (1.72)
ΔlnY_{t-1}	-0.37* (-1.81)	-0.40* (-1.94)	-0.36* (-1.79)	-
ΔlnP_t	-0.14 (-0.90)	0.76 (0.67)	-	-
ΔlnP_{t-1}	-	2.38 (1.59)	-	-
ΔlnP_{t-2}	-	-2.68** (-2.44)	-	-
$\Delta lnER_t$	-0.17 (-1.12)	-	-0.16 (-1.11)	-
$\Delta lnER\_POS_t$	-	-0.24 (-1.53)	-	-1.26 (-1.36)
$\Delta lnER\_NEG_t$	-	-1.42*** (-3.29)	-	1.10 (0.93)
ΔD8	-0.09** (-2.10)	0.01 (0.03)	-0.10*** (-3.10)	0.07 (0.53)
C	-			0.03* (1.97)

Table 4.12: Machinery Group (M = MMG) Cont.….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	1.87*** (3.71)	1.88*** (5.72)	1.75*** (4.83)	
lnP_t	-0.57 (-0.83)	0.65 (1.29)	-	
$lnER_t$	-0.68 (-1.04)	-	-0.67 (-1.02)	
$lnER\_POS_t$	-	-0.63 (-1.46)	-	
$lnER\_NEG_t$	-	-3.80*** (-3.58)	-	
D8	-0.37* (-1.83)	0.00 (0.03)	-0.42*** (-2.76)	
Constant	7.56* (1.87)	3.99** (2.56)	8.15** (2.06)	
	Panel C: Diagnostic Tests			
LM-1 lag	1.90 [0.17]	0.00 [0.98]	1.96 [0.16]	0.27 [0.60]
LM-12 lag	17.11 [0.15]	20.51 [0.09]	17.13 [0.14]	17.25 [0.14]
ARCH-1 lag	0.05 [0.83]	0.01 [0.92]	0.05 [0.82]	0.07 [0.79]
ARCH-12 lag	6.64 [0.88]	5.17 [0.95]	6.83 [0.87]	9.76 [0.64]
Jarque Bera	138.01 [0.00]	94.23 [0.00]	137.79 [0.00]	76.41 {0.00}
ECM (-1)	-0.25*** (-3.75)	-0.37*** (-5.17)	-0.24*** (-3.82)	-
Wald	-	9.60 {1,177} [0.00]	-	1.98 {1,178} [0.16]
CS (CS-SQ)	S(S)	S(S)	S(S)	US(S)
RESET	3.07 {1,176} [0.08]	0.59 {1,176} [0.44]	2.38 {1,177} [0.12]	0.04 {1,177} [0.83]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

In the ARDL model the exchange rate is insignificant in short run as well as long run. However, only nominal exchange rate is significant in case or NARDL in short as well as long run. In short run, NARDL the NER_NEG has a coefficient of -1.4226 implying if there is a 1 percent appreciation in Pak Rupee, the import of machinery would decline by 1.4226 percent and that of in the long run would be 3.8025 percent.

The estimation shows that the lagged values of the import of machinery have negative coefficients. This means that the successive months have less import as compared to the preceding periods.

The Pakistan's industrial production (Y) has significant but mixed results in short run, however, the long run results are positively correlated with the machinery import. Further, the results of NER_ARDL and NER_NARDL are almost similar being 1.8681 and 1.8806 respectively. Whereas the RER_NARDL long run has the Y coefficient of 1.7477 and there

is no RER_NARDL long run relationship of the Y with imports. In this case, the Nominal exchange rate seems to be a better determinant than that of RER.

The ineffectiveness of the RER in the case of machinery import can also be supported by the fact that the prices of the machinery are insignificant in the short run as well long run as shown by the NER_ARDL and NER_NARDL.

The GFC 2007-8 (D8) had a strong impact on the machinery import of Pakistan in the short run when viewed through ARDL and the effect was not visible in the NARDL analysis.

The Error Correction Mechanism (ECM) estimated by the NER_ARDL and NARDL as well as RER_ARDL support that the system is capable of returning to the long term equilibrium if some external shock disturbs it. Ceteris paribus, speed of recovery would be 0.2486, 0.3741 and 0.2432 percent per period (month) respectively for the above models.

The diagnostic tests LM lag 1 and 12 as well as ARCH-1 and 12 are normal maintaining that there is no serial correlation as well as no ARCH effect in the series. However, the series suffer from the normality problem, as the JB stats reject the null of series being normally distributed. The Wald test for NER_NARDL shows that the import of machinery behaves differently when faced by Pak Rupee (PKR) appreciation and depreciation. Contrarily, the Wald stats for the RER_NARDL does not show the different behavior of the machinery import in case of PKR depreciation or appreciation. This is also supported by the short and long run estimations of the ER impact on the machinery import as discussed earlier. Further the CUSUM and CUSUM Squares statistics indicate coefficient stability for all the models except the CUSUM for RER_NARDL.

The models are well specified as the RESET coefficients are unable to reject the null. Therefore the all four models do not suffer from model specification errors.

3. Import – Transport Group (MTG)

In this section the study looks into the relationship of exchange rate with the import of transport related goods into Pakistan. The following tables display the results of NER as well as RER ARDL and NARDL models applied on this very variable.

Table 4.13: Transport Group (M=MTG)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	3,2,0,4	3,2,0,4,0	3,2,1	3,2,0,1
Lags	4	4	3	3
$\Delta lnM_{i,t-1}$	-0.38*** (-4.33)	-0.37*** (-4.41]	-0.35*** (-4.24)	-0.32*** (-3.66)
$\Delta lnM_{i,t-2}$	-0.16** (-2.18)	-0.15** (-2.02)	-0.14* (-1.87)	-0.12* (-1.66)
ΔlnY_t	0.07 (0.23)	-0.14 (-0.46)	0.04 (0.13)	-0.01 (-0.04)
ΔlnY_{t-1}	-0.69** (-2.30)	-0.67** (-2.32)	-0.62** (-2.13)	-0.61** (-2.04)
ΔlnP_t	-0.35 (-1.34)	-0.28 (-1.12)	-	-
$\Delta lnER_t$	0.86 (0.88)	-	1.07 (1.14)	-
$\Delta lnER_{t-1}$	-0.36 (-0.22)	-	-	-
$\Delta lnER_{t-2}$	2.12 (1.22)	-	-	-
$\Delta lnER_{t-3}$	-2.68** (-2.33)	-	-	-
$\Delta lnER\_POS_t$	-	1.17 (1.00)	-	-0.43* (-1.89)
$\Delta lnER\_POS_{t-1}$	-	-0.09 (-0.04)	-	-
$\Delta lnER\_POS_{t-2}$	-	2.46 (1.13)	-	-
$\Delta lnER\_POS_{t-3}$	-	-3.34** (-2.40)	-	-
$\Delta lnER\_NEG_t$	-	-0.77 (-1.23)	-	1.84 (1.08)

Table 4.13: Transport Group (M=MTG) Cont.….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	1.39*** (2.74)	0.83 (1.64)	1.26*** (3.63)	0.78 (1.64)
lnP_t	-0.97 (-1.43)	-0.74 (-1.17)	-	-
$lnER_t$	-0.67 (-0.85)	-	-1.77*** (-3.05)	-
$lnER\_POS_t$	-	-0.62 (-0.78)	-	-1.02* (-1.82)
$lnER\_NEG_t$	-	-2.02 (-1.26)	-	-1.53*** (-3.10)
Constant	8.33* (1.86)	8.03*** (3.37)	13.76*** (3.56)	7.71*** (3.68)
	Panel C: Diagnostic Tests			
LM-1 lag	0.20 [0.65]	0.04 [0.85]	3.17 [0.07]	2.87 [0.09]
LM-12 lag	10.97 [0.53]	9.67 [0.65]	20.18 [0.06]	19.40 [0.08]
ARCH-1 lag	5.05 [0.02]	7.24 [0.01]	8.06 [0.00]	8.23 [0.00]
ARCH-12 lag	13.46 [0.34]	13.52 [0.33]	15.43 [0.22]	19.06 [0.09]
Jarque Bera	1.76 [0.41]	0.40 [0.82]	2.54 [0.28]	2.97 [0.23]
ECM (-1)	-0.36*** (-4.50)	-0.38*** (-4.87)	-0.37*** (-5.03)	-0.42*** (-5.03)
Wald	-	1.90 {1,175} [0.17]	-	1.80 {1,181} [0.18]
CS (CS-SQ)	S(S)	S(S)	S(S)	S(S)
RESET	1.97 {1,176} [0.16]	1.62 {1,174} [0.20]	4.12 {1,181} [0.04]	3.18 {1,180} [0.08]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

The impact of exchange rate on the import of transport is somewhat mixed as per this analysis. In case of NER, the exchange rate coefficients give mixed result in short run and there is only one lag (3^{rd}) that is negatively significant with the coefficient of -2.6829. And for the NER_NARDL ER_POS that is exchange rate depreciation is negatively significant with a coefficient of -3.3356. However for the NER both the ARDL and NARDL models do not show any long run significant relationship. The results of RER models show that there is no significant short run relationship detected by the ARDL model though there is negative significant relationship in the long run. On the other hand the NARDL model of RER detects that there exists weak negatively significant short run relation between the ER_POS and transport items import. On the other hand the ER_POS and ER_NEG both are significant for the RER_NARDL model.

The lags of the dependent variable give mixed significant results in case of ARDL model but are negatively significant in case of the NARDL model of both the NER and RER.

Therefore the NARDL model seems to better explain the relationship between the variables.

The industrial production (Y) has a negative coefficients for the short term estimation but are positively significant only for the ARDL models in the long run. The NARDL models in the long run do not show the significance of the Y in long run.

The prices of the transport goods are insignificant in all the four models for short as well as long run estimates.
In the diagnostic tests, the ECM is negatively significant in all the four models. This explains that the system is able to return to the long run equilibrium when faced with an external shock. The speed of adjustment varies between 0.3640 and 0.4198 based on the nature of the model and exchange rate selection.

The LM-1 and LM-12 (lag 1 and 12) are show the absence of serial correlation in the models analysis. However there is ARCH-1 in the models and still the ARCH-12 are found to be normal. The Jarque Bera (JB) results show that the sample data is normally distributed and no issue of abnormality is found. The Wald test shows that the ER_POS and ER_NEG behave similarly in their impact on the dependent variable. The CUSUM and CUSUM Square are found to be normal implying the stability of the coefficients for all the four models. The RESET stats also show that all the models are well specified, except the RER_ARDL.

4. Import – Petroleum Group (MPT)

Pakistan heavily depends on the import of petroleum goods. These form one of the major chunks of the total Pakistan imports. Following are the estimation results as well as analysis of the results for this variable.

Table 4.14: Petroleum Group (M=MPT)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	3,0,0,4	2,0,1,4,0	4,0,4	3,0,4,1
Lags	4	4	4	4
$\Delta lnM_{i,t-1}$	-0.46*** (-6.61)	-0.21*** (-3.19)	-0.34*** (-4.55)	-0.46*** (-6.53)
$\Delta lnM_{i,t-2}$	-0.17** (-2.46)	-	-0.10 (-1.27)	-0.16** (-2.30)
$\Delta lnM_{i,t-3}$	-	-	0.10 (1.39)	-
ΔlnY_t	0.57* (1.89)	0.89*** (4.22)	0.22 (1.31)	0.53* (1.75)
ΔlnP_t	2.65 (1.52)	1.07 (0.65)	-	-
$\Delta lnER_t$	2.51** (2.38)	-	2.68*** (2.63)	-
$\Delta lnER_{t-1}$	0.72 (0.68)	-	-0.03 (-0.02)	-
$\Delta lnER_{t-2}$	0.53 (0.48)	-	3.44** (1.97)	-
$\Delta lnER_{t-3}$	-4.31*** (-3.64)	-	-2.51** (-2.02)	-
$\Delta lnER\_POS_t$	-	3.59*** (3.00)	-	1.38 (0.88)
$\Delta lnER\_POS_{t-1}$	-	-1.15 (-0.57)	-	0.21 (0.14)
$\Delta lnER\_POS_{t-2}$	-	6.51*** (2.96)	-	0.66 (0.41)
$\Delta lnER\_POS_{t-3}$	-	-3.86*** (-2.68)	-	-5.41*** (-2.87)
$\Delta lnER\_NEG_t$	-	2.41*** (3.57)	-	4.28** (2.16)
C	0.03 (1.64)	-	-	0.05** (2.63)

Table 4.14: Petroleum Group (M=MPT) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t		1.97*** (4.87)	1.20 (1.39)	
lnP_t		-2.85*** (-5.20)	-	
$lnER_t$		-	-1.45 (-1.06)	
$lnER\_POS_t$		-1.19* (-1.71)	-	
$lnER\_NEG_t$		5.36*** (3.89)	-	
Constant		5.66*** (2.97)	14.48 (1.53)	
	Panel C: Diagnostic Tests			
LM-1 lag	2.28 [0.13]	0.11 [0.74]	2.90 [0.09]	0.03 [0.87]
LM-12 lag	14.42 [0.27]	9.43 [0.67]	14.06 [0.30]	12.49 [0.41]
ARCH-1 lag	9.38 [0.00]	4.93 [0.03]	1.96 [0.16]	9.00 [0.00]
ARCH-12 lag	16.50 [0.17]	14.37 [0.28]	7.91 [0.79]	12.71 [0.39]
Jarque Bera	4.49 (0.11)	0.98 [0.61]	1.30 [0.52]	3.26 [0.20]
ECM (-1)	-	-0.45*** (-6.57)	-0.18*** (-4.13)	-
Wald	-	0.70 {1,177} [0.40]	-	0.01 {1,177} [0.93]
CS (CS-SQ)	S(S)	S(S)	US(US)	US(S)
RESET	0.30 {1,180} [0.58]	0.04 {1,176} [0.85]	0.00 {1,178} [0.96]	3.41 {1,179} [0.07]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

The ER impact on the petroleum import is quite mixed as per this analysis. The short term analysis of the ER both nominal and real give mixed results for the ARDL as well NARDL. So no clear cut conclusion be formed. Whereas there is only long run relation for NER_ARDL and RER_ARDL. In the NER_ARDL the ER_POS is faintly negatively significant with a coefficient of -1.1869 and ER_NEG is strongly positively significant with a coefficient of 5.3560.

The Petroleum products show a mixed dependence on their lagged values significantly. Further, with the rising level of Y the petroleum products increase in demand by Pakistan in short as well as long run. The price of the petroleum does not seem to impact the import of it in short run, but does significantly impact it negatively in the long run.

The ECM term makes it clear that the system is capable of reverting to the equilibrium position in the long run as the sign of the ECM is negative and the coefficients are significant.

The diagnostic tests of LM-1 and LM-12 show that there is no serial correlation in all the variables. There is no ARCH effect in the RER_ARDL, whereas the result is mix in other variables. The data sample is also normally distributed as indicated by the JB test stats. The Wald stats show that exchange rate depreciation and appreciation behave similarly for the given variables samples. CUSUM (CS) and CUSUM Square (CS-SQ) are stable in the case of NER, but are mixed for RER. Also, the RESET indicates that the models are well specified.

5. Import – Textile Group (MTX)

Pakistan's basic exports are agricultural products and if specifically checked, cotton is the main export of Pakistan. However, Pakistan imports textile end products on a large scale. The analysis of the imports of textiles is as follows.

Table 4.15: Textile Group (M=MTX)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	4,0,0,0	4,0,0,0,0	6,0,0	4,0,0,0
Lags	4	4	6	4
$\Delta lnM_{i,t-1}$	0.17** (2.24)	0.18** (2.34)	0.01 (0.15)	0.21*** (2.67)
$\Delta lnM_{i,t-2}$	0.15** (2.05)	0.16** (2.11)	0.03 (0.44)	0.18** (2.41)
$\Delta lnM_{i,t-3}$	0.18** (2.40)	0.18** (2.46)	0.04 (0.59)	0.20*** (2.75)
$\Delta lnM_{i,t-4}$	-	-	-0.15** (-2.08)	-
$\Delta lnM_{i,t-5}$	-	-	-0.20*** (-2.79)	-
ΔlnY_t	0.37** (2.33)	0.32* (1.96)	0.37** (2.31)	0.24 (1.44)
ΔlnP_t	-0.54*** (-2.87)	-0.49** (-2.52)	-	-
$\Delta lnER_t$	-0.21 (-1.03)	-	-0.45** (-2.39)	-
$\Delta lnER\_POS_t$	-	-0.25 (-1.17)	-	-0.19 (-0.95)
$\Delta lnER\_NEG_t$	-	-0.67 (-1.43)	-	-0.72*** (-3.65)

Table 4.15: Textile Group (M=MTX) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	0.89** (2.48)	0.75** (2.04)	1.71*** (3.34)	0.50 (1.46)
lnP_t	-1.31*** (-2.94)	-1.15** (-2.54)	-	-
$lnER_t$	-0.52 (-1.00)	-	-2.09** (-2.37)	-
$lnER\_POS_t$	-	-0.57 (-1.14)	-	-0.41 (-0.93)
$lnER\_NEG_t$	-	-1.56 (-1.45)	-	-1.52*** [-3.97}
Constant	10.15*** (3.52)	8.60*** (5.02)	13.32** (2.33)	9.00*** (5.88)
	Panel C: Diagnostic Tests			
LM-1 lag	0.70 [0.40]	0.69 [0.41]	0.83 [0.36]	0.37 [0.54]
LM-12 lag	19.29 [0.08]	18.51 [0.10]	18.79 [0.09]	17.89 [0.12]
ARCH-1 lag	6.46 [0.01]	6.23 [0.01]	3.89 [0.05]	5.65 [0.02]
ARCH-12 lag	11.66 [0.47]	11.23 [0.51]	11.00 [0.53]	10.35 [0.59]
Jarque Bera	23.98 (0.00)	24.51 [0.00]	17.22 [0.00]	23.42 [0.00]
ECM (-1)	-0.41*** (-6.36)	-0.43*** (-6.45)	-0.22*** (-3.91)	-0.48*** (-6.79)
Wald	-	1.18 {1,181} [0.29]	-	14.73 {1,182} [0.00]
CS (CS-SQ)	S(US)	US(US)	S(US)	S(US)
RESET	2.16 {1,181} [0.14]	0.96 {1,180} [0.33]	0.84 {1,178} [0.36]	0.51 {1,181} [0.48]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

The short and long run dynamics of the NER show that the ER is insignificant both in ARDL as well NARDL, however it becomes significant in the long and short run when checked under the RER modeling. Where the ER_NEG is negatively significant implying that when PKR strengthens against USD, the textile import would decline. Although this is strange, but it can be understood if price behavior in the NER models is observed. The price is significant in these models. And also, the price is inbuilt in the RER, therefore the significant impact of the price is captured in the RER models. Therefore, the impact portrayed by the RER is basically that of the price. The price coefficients are negatively significant in short and long run under NER models.

Textile items show a positive significant dependence on its lags. This may imply the habit persistence and the change is slow over the period.

The Y is also positively associated with the demand for textile import in Pakistan. The Y coefficients are positively significant in short and long run models except for the RER_NARD model.

The negative and significant ECM also makes it understood that the system would come to its equilibrium if an external shock disturbs it. The speed of recovery ranges from 0.2177 to 0.4764 per period.

LM-1 and 12 are found to be normal and so are the ARCH-1 and 12. However, the JB stats show that the sample data are not normally distributed. The Wald test shows the consistent behavior of ER_POS and ER_NEG for the NER_NARDL but not for the RER_NARDL. The CUSUM is found to be stable in all the models except the NER_NARDL whereas the CUSUM Square is unstable in all the models. Furthermore, as per the REST stats the models are well specified.

6. Import – Agriculture and other Chemicals Group (MCG)

Pakistan has long been an agricultural country. However, it needs agricultural related chemical and modernly engineered seeds and other such items to be imported.

Table 4.16: Agri. & Other Chemical (M = MCG)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	3,0,1,2	3,0,0,3,0	10,0,2	10,0,3,0
Lags	3	3	10	10
$\Delta lnM_{i,t-1}$	-0.29*** (-3.63)	-0.22*** (-2.64)	-0.37*** (0.00)	-0.19 (-1.59)
$\Delta lnM_{i,t-2}$	-0.17** (-2.52)	-0.14** (-2.03)	-0.17* (0.08)	-0.02 (-0.20)
$\Delta lnM_{i,t-3}$	-	-	0.002 (0.98)	0.12 (1.11)
$\Delta lnM_{i,t-4}$	-	-	-0.11 (-1.12)	0.01 (0.06)
$\Delta lnM_{i,t-5}$	-	-	-0.06 (-0.67)	0.05 (0.45)
$\Delta lnM_{i,t-6}$	-	-	0.05 (0.56)	0.14 (1.49)
$\Delta lnM_{i,t-7}$	-	-	-0.06 (-0.67)	0.01 (0.11)
$\Delta lnM_{i,t-8}$	-	-	-0.28*** (-3.34)	-0.23*** (-2.63)
$\Delta lnM_{i,t-9}$	-	-	-0.17** (-2.34)	-0.15** (-2.01)
ΔlnY_t	0.39*** (3.81)	0.49*** (4.35)	0.36*** (2.98)	0.34*** (2.77)
ΔlnP_t	-2.06** (-2.25)	-0.68*** (-4.07)	-	-
$\Delta lnER_t$	0.56 (1.00)	-	-0.03 (-0.06)	-
$\Delta lnER_{t-1}$	1.18* (1.97)	-	1.25** (2.13)	-
$\Delta lnER\_POS_t$	-	0.86 (1.27)	-	0.97 (1.13)
$\Delta lnER\_POS_{t-1}$	-	0.26 (0.24)	-	0.59 (0.47)
$\Delta lnER\_POS_{t-2}$	-	1.10 (1.48)	-	1.59* (0.09)
$\Delta lnER\_NEG_t$	-	0.001 (0.00)	-	-0.56*** (0.00)
$\Delta D8$	-	-	0.07* (1.74)	0.07* (0.06)

Table 4.16: Agri. & Other Chemical (M = MCG) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	0.74*** (4.16)	0.80*** (4.83)	0.97*** (4.38)	0.55*** (2.82)
lnP_t	-0.92*** (-3.89)	-1.10*** (-5.01)	-	-
$lnER_t$	-0.51* (-1.85)	-	-0.60 (-1.57)	-
$lnER\_POS_t$	-	-0.59** (-2.13)	-	-0.60* (-1.93)
$lnER\_NEG_t$	-	0.002 (0.01)	-	-0.90*** (-3.41)
D8	-	-	0.18** (2.22)	0.12** (2.20)
Constant	11.87*** (7.71)	9.62*** (12.45)	11.06*** (4.69)	10.09*** (11.59)
	Panel C: Diagnostic Tests			
LM-1 lag	0.07 [0.79]	3.34 [0.07]	0.41 [0.52]	0.45 [0.50]
LM-12 lag	16.95 [0.15]	19.78 [0.07]	9.88 [0.63]	10.13 [0.60]
ARCH-1 lag	0.83 [0.36]	0.026 [0.61]	1.72 [0.19]	0.69 [0.41]
ARCH-12 lag	10.02 [0.61]	12.74 [0.39]	10.37 [0.58]	9.12 [0.69]
Jarque Bera	5.93 [0.05]	4.47 [0.11]	0.00 [14.00]	6.56 (0.04)
ECM (-1)	-0.53*** (-06.41)	-0.62*** (-6.67)	-0.37*** (-4.42)	-0.62*** (-4.93)
Wald	-	1.13 {1,179} [0.29]	-	2.67 {1,166} [0.10]
CS (CS-SQ)	S(S)	S(US)	S(US)	S(S)
RESET	0.09 {1,180} [0.76]	0.63 {1,178} [0.43]	1.99 {1,167} [0.16]	0.02 {1,165} [0.89]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

In the short run the ER has a positive significant impact on the Agricultural and other chemicals (MCG) products if considered the NER_ARDL model, and no impact in NER_NARDL model. On the other hand the short run analysis of the RER_ARDL and NARDL shows that the impact is mixed, so no clear conclusion be formed. However, in the long run ER is negatively significant in all the models except the RER_ARDL.

The dependence of the MCG import is mixed in outcomes in different models. Although, the Y is positively significant in all the models under consideration to influence the import of MCG products. Price seems to be strongly positively significant in the NER models. In the short run the coefficient is -2.0566 and that of for the long run is -0.9196. The D8 dummy also is positively significant in the RER term models.

The negative and significant ECM also signifies the stability of the system in the face of an external shock. The speed of recovery ranges from 0.2177 to 0.4764 per period.

LM-1 and 12 are found to be normal and so are the ARCH-1 and 12. However, the JB stats show that the sample data are not normally distributed for RER sample but are normal for the NER. The Wald test shows the consistent behavior of ER_POS and ER_NEG for the RER and NER model. The CUSUM is found to be stable in all the models whereas the CUSUM Square is stable in tow of the models. Moreover, as per the REST stats the models are free of model specification.

7. Import – Metal Group (MMT)

The following tables represents the estimation results of the import of Metal group (MMT), followed by the analysis of the same.

Table 4.17: Metal Group (M = MMT)

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	2,3,4,0	2,3,4,0,4	2,3,0	2,3,0,0
Lags	4	4	3	3
$\Delta lnM_{i,t-1}$	-0.25*** (-3.64)	-0.22*** (-3.12)	-0.23*** (-3.25)	-0.22*** (-3.19)
ΔlnY_t	0.50** (2.39)	0.43** (2.06)	0.59*** (2.79)	0.58*** (2.70)
ΔlnY_{t-1}	-0.02 (-0.08)	-0.02 (-0.09)	0.03 (0.13)	0.04 (0.16)
ΔlnY_{t-2}	-0.70*** (-3.37)	-0.67*** (-3.24)	-0.65*** (-3.12)	-0.63*** (-2.97)
ΔlnP_t	-2.39** (-2.14)	-3.52*** (-3.08)	-	-
ΔlnP_{t-1}	-1.15 (-0.72)	-0.36 (-0.23)	-	-
ΔlnP_{t-2}	-1.20 (-0.75)	-1.73 (-1.09)	-	-
ΔlnP_{t-3}	3.51*** (3.15)	3.20*** (2.83)	-	-
ΔlnP_{t-4}	-	-	-	-
$\Delta lnER_t$	-0.17 (-1.06)	-	-0.21 (-1.49)	-
$\Delta lnER\_POS_t$	-	-0.24 (-1.54)	-	-0.17 (-1.12)
$\Delta lnER\_NEG_t$	-	0.94 (0.57)	-	-0.22 (-1.54)
$\Delta lnER\_NEG_{t-1}$	-	3.27 (1.40)	-	-
$\Delta lnER\_NEG_{t-2}$	-	-6.07** (-2.47)	-	-
$\Delta lnER\_NEG_{t-4}$	-	3.57** (2.07)	-	-

Table 4.17: Metal Group (M = MMT) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	1.99*** (6.49)	1.60*** (5.28)	2.02*** (9.65)	1.88*** (5.51)
lnP_t	-0.40 (-1.13)	-0.26 (-0.82)	-	-
$lnER_t$	-0.42 (-1.05)	-	-0.51 (-1.48)	-
$lnER\_POS_t$	-	-0.55 (-1.52)	-	-0.42 (-1.10)
$lnER\_NEG_t$	-	-2.11** (-2.36)	-	-0.53 (-1.53)
Constant	4.90** (2.13)	4.83*** (3.44)	5.12** (2.22)	3.34** (2.22)
	Panel C: Diagnostic Tests			
LM-1 lag	3.19 [0.07]	0.26 [0.61]	0.00 [0.95]	0.01 [0.90]
LM-12 lag	18.28 [0.11]	16.14 [0.19]	17.57 [0.13]	17.30 [0.14]
ARCH-1 lag	4.46 [0.03]	0.85 [0.36]	2.35 [0.13]	2.26 [0.13]
ARCH-12 lag	29.15 [0.00]	21.86 [0.04]	28.47 [0.00]	28.39 [0.00]
Jarque Bera	0.06 [0.97]	0.22 [0.90]	0.95 [0.62]	0.96 [0.62]
ECM (-1)	-0.40*** [-5.97]	-0.44*** (-6.39)	-0.41*** (-6.04)	-0.41*** (-6.02)
Wald	-	0.53 {1,171} [0.47]	-	0.26 {1,182} [0.61]
CS (CS-SQ)	S(US)	S(S)	S(US)	S(US)
RESET	0.21 {1,176} [0.65]	0.90 {1,170} [0.34]	1.30 {1,182} [0.26]	1.07 {1,181} [0.30]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

The ER impact on the MMT in the short run is either mixed or it is insignificant in all the four modeling techniques. Similar is the case in the long run with an exception of NER_NARDL ER_NEG where the coefficient is negatively significant.

There is negative significant relationship between the past values of the MMT and that of current imports. There are mixed results regarding the Y's coefficient significance in the short run analysis, however in the long run the Y has positive significant coefficients in all the models. The price of the metal goods is negatively significant in determining the demand of the same in Pakistan.

In the Diagnostic stats, it is observed that LM-1, 12 and ARCH-1 are found to be normal and only the ARCH-12 with mixed perspective. According to JB stats the sample data is also normally distributed. The Wald test is evident to show that the ER_POS and ER_NEG behave similarly for the sampled data. The CUSUM is stable for all the coefficients but the

CUSUM Square is unstable for the coefficients except for the NER_NARDL. The models are also well specified as per the RESET stats.

8. Import – Miscellaneous Group (MMI)

Imports in the miscellaneous group are discussed in this section of the estimation.

Table 4.18: Miscellaneous Group (M = MMI)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	9,0,5,0	2,0,0,0,0	2,0,2	2,0,0,2
Lags	9	3	3	3
$\Delta lnM_{i,t-1}$	-0.34*** (-3.61)	-0.23*** (-3.45)	-0.21*** (-3.19)	-0.21*** (-3.21)
$\Delta lnM_{i,t-2}$	-0.07 (-0.76)	-	-	-
$\Delta lnM_{i,t-3}$	-0.11 (-1.29)	-	-	-
$\Delta lnM_{i,t-4}$	-0.24*** (-2.78)	-	-	-
$\Delta lnM_{i,t-5}$	-0.20** (-2.38)	-	-	-
$\Delta lnM_{i,t-6}$	-0.10 (-1.15)	-	-	-
$\Delta lnM_{i,t-7}$	-0.21** (-2.54)	-	-	-
$\Delta lnM_{i,t-8}$	-0.15** (-2.16)	-	-	-
ΔlnY_t	0.37*** (2.87)	0.57*** (4.83)	0.55*** (5.19)	0.52***(4.52)
ΔlnP_t	-1.27 (-1.45)	-0.62*** (-4.71)	-	-
ΔlnP_{t-1}	-1.14 (-0.91)	-	-	-
ΔlnP_{t-2}	-0.34 (-0.27)	-	-	-
ΔlnP_{t-3}	-0.32 (-0.25)	-	-	-
ΔlnP_{t-4}	1.92** (2.20)	-	-	-
$\Delta lnER_t$	-0.58*** (-4.29)	-	-0.27 (-0.56)	-
$\Delta lnER_{t-1}$	-	-	1.06** (2.01)	-
$\Delta lnER\_POS_t$	-	-0.60*** (-4.46)	-	-0.61*** (-4.63)
$\Delta lnER\_NEG_t$	-	-0.54** (-2.01)	-	0.72 (0.81)
$\Delta lnER\_NEG_{t-1}$	-	-	-	1.28 (1.40)

Table 4.18: Miscellaneous Group (M = MMI) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	1.01*** (3.97)	1.24*** (6.27)	1.13*** (8.18)	1.09*** (5.40)
lnP_t	-1.54)*** (-4.68)	-1.37*** (-5.63)	-	-
$lnER_t$	-1.60*** (-3.79)	-	-1.53*** (-6.63)	-
$lnER\_POS_t$	-	-1.31*** (-4.78)	-	-1.27*** (-5.04)
$lnER\_NEG_t$	-	-1.19** (-2.03)	-	-1.38*** (-6.29)
Constant	13.56*** (6.05)	5.85*** (6.37)	12.61*** (8.18)	5.75*** (6.44)
	Panel C: Diagnostic Tests			
LM-1 lag	0.08 [0.77]	0.97 [0.32]	0.86 [0.35]	1.1567 [0.28]
LM-12 lag	18.62 [0.10]	29.16 [0.00]	26.61 [0.01]	28.09 [0.01]
ARCH-1 lag	8.83 [0.00]	14.23 [0.00]	8.19 [0.00]	7.47 [0.01]
ARCH-12 lag	22.62 [0.03]	33.09 [0.00]	26.18 [0.01]	25.00 [0.01]
Jarque Bera	1.00 [0.61]	1.48 [0.48]	0.58 [0.58]	0.73 [0.69]
ECM (-1)	-0.36*** (-4.49)	-0.46*** (-6.89)	-0.49*** (-7.42)	-0.48*** (-7.09)
Wald	-	0.07 {1,185} [0.80]	-	2.27 {1,183} [0.13]
CS (CS-SQ)	S(S)	S(US)	S(S)	S(S)
RESET	0.07 {1,166} [0.79]	1.74 {1,184} [0.19]	0.23 {1,184} [0.63]	0.03 {1,182} [0.87]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

The short run ER analysis of the MMI category shows that the NER has negative significant coefficients, the RER_ARDL has a significant positive coefficient but the RER_NARDL has a significant negative coefficient. Nonetheless, the long run coefficients of the ER are all negatively significant.

In short run price of the MMI goods has a positive significant coefficient for the NER_ARDL and negative significant for the NER_NARDL. Where as in the long run the price has a negative significant coefficients for both the applicable models.

The import of MMI items is negatively associated with its lagged values as most of the lagged coefficients are negatively significant. Apart from the lagged values, the MMI is positively associated with the industrial production or income of Pakistan.

As rest of the model, the ECM of this variable also indicates the tendency of the system to revert to equilibrium after a shock is faced by the economy, given other factors constant.

The series has no LM-1 issue but this is the only series that has maintained serial correlation issue even up-to the 12^{th} lag. There is also ARCH-1 and 12 in the series. However, the sampled series are normally distributed as per the JB stats. The Wald test also explains that the ER behaves similarly when it strengthens or weakens. CUSUM and CUSUM Square indicate that almost all the coefficients are stable. The models are sound in specification as are evident from the RESET statistics.

9. Import – All Other Group (MAO)

This category of the import includes all the imports items or import all others (MAO) which have not been taken care of in any other category. Following are the estimations results and subsequent analysis.

Table 4.19: All Others (M = MAO)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	1,3,4,1	1,3,4,1,0	1,3,3	1,3,0,3
Lags	4	4	3	3
ΔlnY_t	0.92*** (2.84)	0.92*** (2.82)	0.87*** (2.68)	0.81** (2.45)
ΔlnY_{t-1}	-0.05 (-0.12)	-0.04 (-0.11)	-0.19 (-0.48)	-0.17 (-0.45)
ΔlnY_{t-2}	-1.00*** (-3.04)	-0.95*** (-2.88)	-0.95*** (-2.93)	-0.93*** (-2.82)
ΔlnP_t	2.43 (1.36)	2.34 (1.26)	-	-
ΔlnP_{t-1}	6.11** (2.46)	6.02** (2.41)	-	-
ΔlnP_{t-2}	-8.10*** (-3.10)	-7.94*** (-3.01)	-	-
ΔlnP_{t-3}	2.91 (1.60)	2.52 (1.34)	-	-
$\Delta lnER_t$	2.01* (1.89)	-	2.411** (2.31)	-
$\Delta lnER_{t-1}$	-	-	3.25** (2.08)	-
$\Delta lnER_{t-2}$	-	-	-2.08* (-1.74)	-
$\Delta lnER\_POS_t$	-	2.09 (1.62)	-	0.56** (2.22)
$\Delta lnER\_NEG_t$	-	-0.18 (-0.28)	-	5.06*** (2.70)
$\Delta lnER\_NEG_{t-1}$	-	-	-	5.65** (2.09)
$\Delta lnER\_NEG_{t-2}$	-	-	-	-4.68** (-2.34)
$\Delta D8$	-	-	0.12** (2.20)	0.08 (1.35)

Table 4.19: All Others (M = MAO) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	1.78*** (7.75)	1.72*** (6.80)	1.99*** (10.64)	1.72*** (6.93)
lnP_t	0.003 (0.01)	0.03 (0.09)	-	-
$lnER_t$	0.26 (0.85)	-	0.31 (0.95)	-
$lnER\_POS_t$	-	0.18 (0.54)	-	0.62** (2.25)
$lnER\_NEG_t$	-	-0.22 (-0.28)	-	0.30 (1.07)
D8	-	-	0.14** (0.03)	0.09 (1.36)
Constant	2.97* (1.68)	4.27*** (3.64)	1.69 (0.81)	4.34*** (3.95)
	Panel C: Diagnostic Tests			
LM-1 lag	3.05 [0.08]	2.80 [0.09]	0.57 [0.45]	0.08 [0.78]
LM-12 lag	18.36 [0.10]	17.96 [0.12]	14.43 [0.27]	13.23 [0.35]
ARCH-1 lag	0.68 [0.41]	0.76 [0.38]	0.10 [0.76]	0.41 [0.52]
ARCH-12 lag	14.65 [0.26]	13.46 [0.34]	18.26 [0.11]	20.52 [0.06]
Jarque Bera	12.45 [0.00]	11.94 [0.00]	18.70 [0.00]	14.74 [0.00]
ECM (-1)	-0.85*** (-11.68)	-0.84*** (-11.61)	-0.87*** (-12.09)	-0.90*** (-12.62)
Wald	-	2.21 {1,176} [0.14]	-	5.89 {1,178} [0.01]
CS (CS-SQ)	S(US)	S(US)	S(US)	S(US)
RESET	2.78 {1,176} [0.10]	3.12 {1,175} [0.08]	3.97 {1,179} [0.05]	2.37 {1,177} [0.13]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

This series has a significant positive ER coefficient in the NER_ARDL and mixed significant coefficients in the RER_ARDL and RER_NARDL. In the long run, ER coefficient of ER_POS for the RER_NARDL is positively significant. Apart from this, the ER is not significant in long run for any of the data sample series. Price also has mixed results in short run and no significance at all in the long run. The Y has mixed significance in the short run but in the long run the Y has positive significant coefficients. It is also observable that the D8 dummy is significant in the RER_ARDL analysis in short as well as long run results.

The diagnostics show that the negatively significant ECM coefficient would allow the system to return to the equilibrium in long run if faced by an external shock, given other thigs remain the same way. The LM-1, LM-12, ARCH-1 and ARCH-12 are all normal and no issue of serial correlation as well as ARCH effect is found in the data sample. However, the data sample does not agree to the normality condition as the JB stats show. The Wald

test shows that the ER behavior in the NER_NARDL is symmetric and that of the RER_NARDL is asymmetric. The CUSUM stats show the stability of the all the coefficients whereas the CUSUM Square goes the contrary. Again all the models are well specified as per the RESET except for the RER_ARDL.

10. Import – Grand Total Payments Through Banks (MGT)

This category is the sum total of the money value paid by the Pakistan of the all the imports made into the country. So these are called the Import Grand Total (MGT). Following are the estimation outputs of this variable and analysis is followed after that.

Table 4.20: Total Imports (M = MGT)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	2,3,0,2	2,3,0,2,0	2,3,2	2,3,2,1
Lags	3	3	3	3
$\Delta lnM_{i,t-1}$	-0.17** (-2.44)	-0.12* (-1.71)	-0.18** (-2.60)	-0.17** (-2.44)
ΔlnY_t	0.54*** (3.97)	0.62*** (4.57)	0.51*** (3.73)	0.56*** (4.07)
ΔlnY_{t-1}	-0.13 (-0.76)	-0.18 (-1.06)	-0.11 (-0.64)	-0.17 (-0.97)
ΔlnY_{t-2}	-0.30** (-2.13)	-0.34** (-2.44)	-0.28** (-2.03)	-0.30** (-2.15)
ΔlnP_t	-0.39*** (-3.06)	-0.62*** (-4.02)	-	-
$\Delta lnER_t$	0.81* (1.81)	-	0.88** (2.06)	-
$\Delta lnER_{t-1}$	1.02** (2.07)	-	0.86* (1.85)	-
$\Delta lnER\_POS_t$	-	0.84 (1.57)	-	0.35 (0.52)
$\Delta lnER\_POS_{t-1}$	-	1.13* (1.91)	-	1.80** (2.59)
$\Delta lnER\_NEG_t$	-	0.26 (0.36)	-	1.71** (2.04)
$\Delta D8$	0.07* (1.87)	0.02 (0.64)	0.06** (2.15)	0.08*** (2.68)

Table 4.20: Total Imports (M = MGT) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	1.44*** (7.25)	1.61*** (9.35)	1.31*** (8.29)	1.60*** (7.27)
lnP_t	-0.89*** (-3.07)	-1.20*** (-4.39)	-	-
$lnER_t$	-1.00*** (-3.48)	-	-0.80*** (-2.85)	-
$lnER\_POS_t$	-	-0.85*** (-3.37)	-	-0.96*** (-3.13)
$lnER\_NEG_t$	-	0.50 (0.93)	-	-0.70** (-2.40)
D8	0.15** (2.04)	0.05 (0.64)	0.15** (2.53)	0.19*** (3.16)
Constant	12.47*** (7.25)	7.83*** (9.57)	12.21*** (7.07)	7.23*** (7.46)
	Panel C: Diagnostic Tests			
LM-1 lag	1.09 [0.30]	1.17 [0.28]	0.11 [0.74]	0.21 [0.64]
LM-12 lag	17.36 [0.14]	14.99 [0.24]	16.03 [0.19]	15.53 [0.21]
ARCH-1 lag	0.00 [0.96]	0.00 [0.95]	0.00 [95]	0.50 [0.48]
ARCH-12 lag	15.38 [0.22]	13.67 [0.32]	12.07 [0.44]	8.11 [0.78]
Jarque Bera	5.20 [0.07]	4.50 [0.10]	5.00 [0.08]	4.96 [0.08]
ECM (-1)	-0.43*** (-6.65)	-0.52*** (-7.25)	-0.40*** (-6.37)	-0.42*** (-6.56)
Wald	-	0.87 {1,178} [0.35]	-	1.19 {1,178} [0.28]
CS (CS-SQ)	S(S)	S(S)	S(S)	S(S)
RESET	1.66 {1,178} [0.20]	0.14 {1,177} [0.70]	3.43 {1,179} [0.07]	0.94 {1,177} [0.33]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

The ER coefficient results are very interesting in a way that they conform to the theory of J-Curve. In the short run the coefficients of the ER are positively significant and in the long run all of them become negatively significant in all the four models. This implies that the imports are supposed to worsen the trade balance initially, but in the long run the demand of the imported goods is supposed to fall to adjust for the increased prices.

Imports are negatively significant in coefficients of their lagged values. Similar is the case with the national income or Y. However the coefficients of the Y are positively significant in the long run. This implies that in the long run, more imports are needed as the national income of Pakistan grows. It is also to be noted that relative price (P) has a negative and) significant coefficient in the short and long run. The analysis also reveals that the GFC 2007-8 (D8) has a positive and significant coefficient in the three of four models expect in the NER_NARDL in short and long run.

In the diagnostics, it is learned that the data sample does not suffer from any of the LM and or ARCH issues and also the data complies with the normality condition. The negative and significant ECM coefficients make the system stable in the long run and self-correcting toward the equilibrium. The Wald test shows that there is no asymmetric behavior of the ER in this data sample and modeling technique. CUSUM and CUSUM Square show the coefficient stability and RESET shows that the models do not suffer from model specification errors.

Empirical evidence from other researches on imports and exchange rate: All the models for imports in this study show that real exchange rate has negative while domestic income has positive influence on the imports in case of linear ARDL model. As for as the findings of non-linear ARDL models for imports are concerned, the most of the imports models show that appreciation and depreciation of exchange rate determine the trade balance negatively while in some models, depreciation of exchange rate affects trade balance positively. The similar findings have been discussed in earlier studies (Bahmani-Oskooee & Kanitpong, 2017; Arize et. al 2017; Lossifov and Fei, 2019)

B. The second part of the ARDL analysis discusses the exports of Pakistan to rest of the world.

1. Export – Food Group (XFO)

This section of the estimation pertains to the export of the Food Groups items from Pakistan to rest of the world.

Table 4.21: Food Group (X=XFO)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	12,11,0,0	12,11,0,0,0	12,11,0	12,11,0,0
Lags	12	12	12	12
$\Delta lnX_{i,t-1}$	-0.15 (-1.42)	-0.12 (-0.98)	-0.10 (-1.11)	-0.14 (-1.33)
$\Delta lnX_{i,t-2}$	-0.13 (-1.23)	-0.10 (-0.82)	-0.07 (-0.88)	-0.11 (-1.13)
$\Delta lnX_{i,t-3}$	-0.05*(-0.51)	-0.02 (-0.21)	0.001 (-0.01)	-0.03 (-0.35)
$\Delta lnX_{i,t-4}$	-0.24** (-2.51)	-0.21* (-1.96)	-0.19** (-2.41)	-0.22** (-2.51)
$\Delta lnX_{i,t-5}$	-0.26*** (-2.89)	-0.24** (-2.34)	-0.22*** (-2.86)	-0.24*** (-2.91)
$\Delta lnX_{i,t-6}$	-0.26*** (-3.05)	-0.25*** (-2.63)	-0.23*** (-3.00)	-0.25*** (-3.05)
$\Delta lnX_{i,t-7}$	-0.34*** (-4.08)	-0.32*** (-3.70)	-0.31*** (-4.08)	-0.33*** (-4.09)
$\Delta lnX_{i,t-8}$	-0.33*** (-4.11)	-0.32*** (-3.82)	-0.31*** (-4.07)	-0.33*** (-4.10)
$\Delta lnX_{i,t-9}$	-0.25*** (-2.95)	-0.24*** (-2.75)	-0.22*** (-2.82)	-0.24*** (-2.92)
$\Delta lnX_{i,t-10}$	-0.33*** (-4.18)	-0.33*** (-4.00)	-0.31*** (-4.09)	-0.33*** (-4.15)
$\Delta lnX_{i,t-11}$	-0.20** (-2.51)	-0.19** (-2.42)	-0.18** (-2.38)	-0.19** (-2.47)
$\Delta lnY_{f,\,t}$	-0.46 (-0.53)	-0.45 (-0.52)	-0.60 (-0.70)	-0.46 (-0.52)
$\Delta lnY_{f,t-1}$	-0.66 (-0.63)	-0.63 (-0.60)	-0.64 (-0.60)	-0.64 (-0.60)
$\Delta lnY_{f,t-2}$	0.06 (0.06)	0.06 (-0.06)	0.05 (-0.05)	0.06 (0.06)
$\Delta lnY_{f,t-3}$	-0.26 (-0.26)	-0.26 (-0.26)	-0.27 (-0.27)	-0.27 (-0.26)
$\Delta lnY_{f,t-4}$	-1.76* (-1.77)	-1.76* (-1.77)	-1.81* (-1.84)	-1.77* (-1.79)
$\Delta lnY_{f,t-5}$	1.21 (1.20)	1.20 (1.19)	1.16 (1.15)	1.20 (1.19)
$\Delta lnY_{f,t-6}$	-0.19 (-0.19)	-0.21 (-0.21)	-0.24 (-0.24)	-0.21 (-0.21)
$\Delta lnY_{f,t-7}$	2.23** (2.24)	2.22** (2.23)	2.23** (2.25)	2.22** (2.23)
$\Delta lnY_{f,t-8}$	-2.36** (-2.36)	-2.38** (-2.38)	-2.40** (-2.41)	-2.38** (-2.38)
$\Delta lnY_{f,t-9}$	0.14 (0.15)	0.12 (0.12)	0.13 (0.14)	0.13 (0.14)
$\Delta lnY_{f,t-10}$	1.59* (1.97)	1.57* (1.93)	1.69** (2.11)	1.60* (1.97)
ΔlnP_t	0.13 (0.78)	0.02 (0.08)	-	-
$\Delta lnER_t$	0.03 (0.84)	-	0.042 (0.31)	-
$\Delta lnER\_POS_t$	-	0.02 (0.17)	-	0.02 (0.12)
$\Delta lnER\_NEG_t$	-	0.22 (0.50)	-	0.10 (0.62)
ΔD8	0.25*** (4.14)	0.24*** (3.87)	0.24*** (4.06)	0.25*** (4.12)

Table 4.21: Food Group (X=XFO) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	1.38 (1.19)	1.48 (1.40)	0.77 (1.10)	1.42 (1.19)
lnP_t	0.50 (0.68)	0.08 (0.08)	-	-
$lnER_t$	0.11 (0.20)	-	0.14 (0.31)	-
$lnER\_POS_t$	-	0.08 (0.16)	-	0.06 (0.12)
$lnER\_NEG_t$	-	0.78 (0.56)	-	0.35 (0.58)
D8	1.00*** (3.07)	0.86** (2.29)	0.77*** (8.41)	0.90*** (4.28)
Constant	4.85 (0.81)	5.05 (1.02)	7.71* (1.97)	5.40 (0.98)
	Panel C: Diagnostic Tests			
LM-1 lag	0.09 [0.76]	0.12 [0.73]	0.18 [0.67]	0.12 [0.73]
LM-12 lag	14.32 [0.28]	14.25 [0.29]	13.23 [0.35]	13.74 [0.32]
ARCH-1 lag	3.38 [0.07]	3.28 [0.07]	3.52 [0.06]	3.34 [0.07]
ARCH-12 lag	10.53 [0.57]	10.36 [0.58]	9.79 [0.63]	10.18 [0.60]
Jarque Bera	3.01 [0.22]	3.25 [0.20]	2.87 [0.24]	3.18 [0.20]
ECM (-1)	-0.25*** (-2.86)	-0.29** (-2.52)	-0.30*** (-4.60)	-0.27*** (-3.51)
Wald	-	0.21 {1,153} [0.65]	-	0.59 {1,154} [0.44]
CS (CS-SQ)	S(S)	S(S)	S(S)	S(S)
RESET	0.64 {1,153} [0.43]	0.57 {1,152} [0.45}	0.99 {1,154} [0.32]	0.69 {1,153} [0.41]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

Exchange Rate or ER being main determinant and focus in this study, it is the first variable to be shed light upon. However in this analysis none of the model has ER significant in neither short run nor long run. Also the prices of the food item do not seem to be affecting the export of food items.

The only coefficients significant are those of the XFO lagged values and the world Income or Y_f. In case of XFO lags, the coefficients are negatively significant in all the four models. Implying the previous period's higher exports would lead to the lesser exports of the current period. This might be due to the supply constraint from Pakistani perspective or it can also be due to the limited demand for the Pakistani food related items abroad. Looking at the world income and the associated coefficients, the significant coefficients are mixed and no distinct result can be drawn based on these estimates. However, in the long run Y_f does not have any significant coefficient.

The ECM is negatively significant, indicating that they system would revert to the long run equilibrium after it faces an external shock. The LM and, ARCH results are normal and also the JB indicates the normality of the sample data. Wald test stats indicate that the ER behaves symmetrically while it appreciates or depreciates. The CUSUM and CUSUM Square indicate the stability of the coefficients in all the four models. RESET stats also indicate that the model does not suffer from model specification error.

2. Export – Textile Group (XTX)

Export of Textile Group (XTX) is one of the major export category of Pakistan. The following tables and then analysis sheds light on this category's exports and exchange rate's influence on it.

Table 4.22: Textile Group (X=XTX)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	5,12,0,1	5,7,2,0,0	5,11,1	5.12.0.1
Lags	12	7	11	12
$\Delta lnX_{i,t-1}$	-0.68*** (-7.12)	-0.54*** (-5.16)	0.68*** (-7.57)	-0.70*** (-7.52]
$\Delta lnX_{i,t-2}$	-0.26** (-2.30)	-0.16 (-1.46)	-0.26** (-2.45)	-0.27** (-2.46)
$\Delta lnX_{i,t-3}$	0.28*** (2.71)	0.35*** (3.31)	0.274*** (2.63)	0.29*** (2.81)
$\Delta lnX_{i,t-4}$	0.21*** (2.69)	0.26*** (3.48)	0.21*** (2.66)	0.22*** (2.85)
$\Delta lnY_{f,\,t}$	0.56 (1.32)	0.79** (2.08)	0.41 (1.01)	0.61 (1.38)
$\Delta lnY_{f,t-1}$	-1.10** (-2.20)	-0.87* (-1.90)	-1.02** -2.07)	-1.17** (-2.36)
$\Delta lnY_{f,t-2}$	0.46 (0.94)	0.04 (0.08)	0.76 (1.56)	0.48 (0.98)
$\Delta lnY_{f,t-3}$	0.59 (1.20)	0.02 (0.04)	0.34 (0.71)	0.61 (1.25)
$\Delta lnY_{f,t-4}$	0.90* (1.89)	1.18*** (2.79)	0.66 (1.42)	0.89* (1.88)
$\Delta lnY_{f,t-5}$	-0.20 (-0.43)	0.50 (1.20)	0.06 (0.13)	-0.07 (-0.15)
$\Delta lnY_{f,t-6}$	-1.01** (-2.11)	-1.10*** (-3.13)	-0.79* (-1.67)	-1.04** (-2.20)
$\Delta lnY_{f,t-7}$	0.82* (1.71)	-	0.69 (1.46)	0.82* (1.74)
$\Delta lnY_{f,t-8}$	-0.80* (-1.67)	-	-0.94* (-1.97)	-0.82* (-1.71)
$\Delta lnY_{f,t-9}$	-1.08** (-2.25)	-	-0.68 (-1.52)	-1.06** (-2.22)
$\Delta lnY_{f,t-10}$	0.64 (1.30)	-	1.23*** (3.26)	0.62 (1.28)
$\Delta lnY_{f,t-11}$	0.92** (2.24)	-	-	0.93** (2.28)
ΔlnP_t	-0.23*** (-2.81)	0.22 (0.44)	-	-
ΔlnP_{t-1}	-	0.74 (1.52)	-	-
$\Delta lnER_t$	0.33 (1.17)	-	0.41 (1.42)	-
$\Delta lnER\_POS_t$	-	-0.15* (-1.91)	-	-0.06 (-0.77)
$\Delta lnER\_NEG_t$	-	0.49** (2.52)	-	0.99* (-1.92)
$\Delta D8$	-	-	0.05** (2.37)	0.04* (1.74)

Table 4.22: Textile Group (X=XTX) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	-0.25 (-0.61)	1.14*** (4.08)	0.44 (0.88)	-0.12 (-0.20)
lnP_t	-0.76*** (-3.94)	-1.06*** (-7.32)	-	-
$lnER_t$	-0.40* (-1.68)	-	-0.57* (-1.96)	-
$lnER\_POS_t$	-	-0.34** (-2.13)	-	-0.21 (-0.81)
$lnER\_NEG_t$	-	1.13*** (2.91)	-	-0.45* (-1.78)
D8	-	-	0.21*** (3.41)	0.15* (1.88)
Constant	16.70*** (8.11)	8.77*** (6.84)	14.09*** (4.89)	14.07*** (5.08)
	Panel C: Diagnostic Tests			
LM-1 lag	0.00 [0.95]	0.16 [0.69]	1.62 [0.20]	0.04 [0.84]
LM-12 lag	13.64 [0.32]	13.01 [0.37]	14.06 [0.30]	13.94 [0.30]
ARCH-1 lag	0.12 [0.73]	1.55 [0.21]	0.43 [0.51]	0.08 [0.77]
ARCH-12 lag	6.79 [0.87]	9.84 [0.63]	6.40 [0.89]	5.09 [0.95]
Jarque Bera	15.30 [0.00]	15.87 [0.00]	12.84 [0.00]	13.23 [0.00]
ECM (-1)	-0.30*** (-3.97]	-0.43*** (-4.40)	-0.23*** (-3.54)	-0.26*** (-3.80)
Wald	-	10.46 {1,168} [0.00]	-	4.35 {1,159} [0.04]
CS (CS-SQ)	S(S)	S(S)	S(S)	S(S)
RESET	2.13 {1,159} [0.15]	0.53 {1,167} [0.47]	0.85 {1,161} [0.36]	1.66 {1,158} [0.20]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

In the short run the linear models do not capture the effect of the ER changes on the XTX. However in the long run the linear models of NER and RER have negative significant coefficients. This means that in the long run, when PKR weakens the XTX category will face lower exports and when it strengthens the exports would rise. While looking at the NARDL models ER coefficients, the ER_POS has negative significant coefficients and that of the ER_NEG are positively significant. This is also supported by the Wald stats that shows asymmetric behavior of the ER changes. The negative coefficients of the ER_POS mean that when the exchange rate depreciates by 1 percent the export of textile from Pakistan would decline at the rate of 0.3378 and 0.2135 as per NER_ARDL and RER_NARDL respectively.

In the short run, coefficients of the lagged values give mix results, making it unclear in which direction the exports would move in short run. Similar is the case with Y_f where the coefficients are of mixed nature. In the long run the world income is negatively significant

in the NER_ARDL model where as it becomes positively significant in the NARDL model. Yet it is insignificant for the RER models in the long run.

In short run, price has negative significant coefficient in NER_ARDL only. In the long run the NER model overall has negatively significant price coefficients. Furthermore, the D8 is significant when the RER model is considered for long as well as short run estimations. The negative and significant ECM implies that the system is stable and has the capability to return to long run equilibrium after an external shock hits the system, given the other parameters remain constant. The diagnostic stats for the LM and ARCH are normal. However, the data sample does not comply with the normality assumptions. The CUSUM and CUSUM Square are found to be stable for these models and also the RESET stats show error free model specification for XTX category of the export from Pakistan.

3. Export – Petroleum Group (XPT)

Though Pakistan imports the petroleum products, it does export some of the petroleum products too. Following are the Export of petroleum (XPT) category analysis of the Pakistan's exports.

Table 4.23: Petroleum Group (X=XPT)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	3,0,0,2	3,0,0,2,0	3,0,2	3,0,2,0
Lags	3	3	3	3
$\Delta lnX_{i,t-1}$	-0.58*** (-8.49)	-0.55*** (-7.64)	-0.57*** (-8.29)	-0.57*** (-8.28)
$\Delta lnX_{i,t-2}$	-0.36*** (-5.62)	-0.35*** (-5.38)	-0.35*** (-5.37)	-0.35*(-5.39)
$\Delta lnY_{f,t}$	-0.28 (-0.59)	0.27 (0.46)	-0.41 (-0.88)	-0.41 (-0.79)
ΔlnP_t	0.11 (0.34)	-0.18 (-0.47)	-	-
$\Delta lnER_t$	2.73* (1.84)	-	1.87 (1.30)	-
$\Delta lnER_{t-1}$	-3.29** (-2.08)	-	-2.89* (-1.97)	-
$\Delta lnER\_POS_t$	-	3.08* (1.73)	-	1.87 (0.87)
$\Delta lnER\_POS_{t-1}$	-	-4.51** (-2.35)	-	-2.89 (-1.25)
$\Delta lnER\_NEG_t$	-	1.46 (1.46)	-	2.63*** (8.04)

Table 4.23: Petroleum Group (X=XPT) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	-1.60 (-0.59)	1.20 (0.47)	-2.35 (-0.88)	-2.35 (-0.78)
lnP_t	0.62 (0.33)	-0.82 (-0.50)	-	-
$lnER_t$	-0.08 (-0.03)	-	1.57 (0.98)	-
$lnER\_POS_t$	-	0.28 (0.14)	-	1.57 (0.59)
$lnER\_NEG_t$	-	6.53 (1.58)	-	15.09*** (3.09)
Constant	18.98 (1.19)	6.23 (0.52)	15.09 (0.95)	14.89 (1.09)
	Panel C: Diagnostic Tests			
LM-1 lag	0.92 [0.34]	0.84 [0.36]	0.96 [0.33]	0.80 [0.37]
LM-12 lag	6.75 [0.87]	6.15 [0.91]	5.71 [0.93]	5.46 [0.94]
ARCH-1 lag	0.000 [0.99]	0.13 [0.72]	0.03 [0.86]	0.143 [0.71]
ARCH-12 lag	19.24 [0.08]	22.43 [0.03]	16.79 [0.16]	18.64 [0.10]
Jarque Bera	19.26 [0.00]	21.51 [0.00]	26.03 [0.00]	22.90 [0.00]
ECM (-1)	-0.18*** (-3.93)	-0.22*** (-4.04)	-0.17*** (-4.06)	-0.17*** (-3.86)
Wald	-	0.55 {1,181} [0.46]	-	1.34 {1,182} [0.25]
CS (CS-SQ)	S(US)	S(US)	S(US)	S(US)
RESET	3.21 {1,181} [0.07]	2.97 {1,180} [0.09]	3.19 {1,182} [0.08]	2.92 {1,181} [0.09]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

The XPT category analysis reveals that in the short and long run only the ER_NEG of the RER_NARDL is positively significant, and all other ER coefficients are insignificant and or mixed in results. The Wald test for the RER_NARDL shows that the ER coefficient is symmetric in behavior for this model.

The XPT lags are negatively significant for all the models in short run implying a negative association between the past exports of petroleum and the present exports. World income as well as the prices of the Pakistani XPT are insignificant in determination of the XPT exports in short and long run.

The ECM coefficient is negatively significant for all the four models, implying the ability of the system to revert to long run equilibrium in the aftermath of a shock in economy. The

diagnostic stats for the LM and ARCH are normal. However, the data sample does not comply with the normality assumptions. The CUSUM is stable and CUSUM Square are found to be unstable for these models. Accordingly, the RESET stats show error free model specification for XPT category of the export from Pakistan.

4. Export – Other Manufacturing Group (XOM)

The Other Manufacturing Group of exports (XOM) is the export of manufactured items which do not fit into rest of the categories. Here is the estimation output and the analysis for this variable.

Table 4.24: Other Manufacture (X=XOM)

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	7,7,4,0	5,1,5,0,0	11,11,0	12,12,0,0
Lags	7	5	11	12
$\Delta lnX_{i,t-1}$	-0.52*** (-6.01)	-0.27*** (-3.01)	-0.52*** (-5.98)	-0.59*** (-6.99)
$\Delta lnX_{i,t-2}$	-0.13 (-1.56)	0.03 (0.35)	-0.18* (-1.95)	-0.31*** (-3.26)
$\Delta lnX_{i,t-3}$	0.23*** (2.63)	0.41*** (4.82)	0.19** (2.07)	0.03 (0.35)
$\Delta lnX_{i,t-4}$	-0.09 (-0.93)	0.17** (2.42)	0.03 (0.31)	-0.11 (-1.18)
$\Delta lnX_{i,t-5}$	-0.28*** (-3.11)	-	-0.19** (-2.09)	-0.30*** (-3.22)
$\Delta lnX_{i,t-6}$	-0.13 (-1.64)	-	-0.20** (-2.24)	-0.30*** (-3.20)
$\Delta lnX_{i,t-7}$	-	-	-0.24** (-2.54)	-0.32*** (-3.42)
$\Delta lnX_{i,t-8}$	-	-	-0.30*** (-2.98)	-0.37*** (-3.77)
$\Delta lnX_{i,t-9}$	-	-	-0.17* (-1.78)	-0.32*** *-3.13)
$\Delta lnX_{i,t-10}$	-	-	-0.19** (-2.49)	-0.36*** (-3.76)
$\Delta lnX_{i,t-11}$	-	-	-	-0.17** (-2.16)
$\Delta lnY_{f,t}$	0.61 (1.09)	0.17 (0.38)	-0.35 (-0.59)	0.43 (0.66)
$\Delta lnY_{f,t-1}$	-1.14* (-1.74)	-	-1.22* (-1.71)	-1.05 (-1.52)
$\Delta lnY_{f,t-2}$	0.52 (0.79)	-	0.74 (1.04)	0.56 (0.82)
$\Delta lnY_{f,t-3}$	0.89 (1.34)	-	0.38 (0.54)	0.43 (0.62)
$\Delta lnY_{f,t-4}$	1.56** (2.49)	-	0.87 (1.28)	0.85 (1.24)
$\Delta lnY_{f,t-5}$	-0.11 (-0.19)	-	0.01 (0.02)	-0.09 (-0.13)
$\Delta lnY_{f,t-6}$	-0.95* (-1.88)	-	-1.57** (-2.33)	-1.36** (-2.07)
$\Delta lnY_{f,t-7}$	-	-	-0.46 (-0.67)	-0.39 (-0.58)
$\Delta lnY_{f,t-8}$	-	-	-1.01 (-1.50)	-0.87 (-1.32)
$\Delta lnY_{f,t-9}$	-	-	0.46 (0.76)	0.09 (0.14)
$\Delta lnY_{f,t-10}$	-	-	2.06*** (-1.54)	1.34** (2.20)
$\Delta lnY_{f,t-11}$	-	-	-	0.93 (1.56)
ΔlnP_t	0.24 (0.31)	-0.08 (-0.11)	-	-
ΔlnP_{t-1}	1.21 (1.22)	0.88 (0.90)	-	-
ΔlnP_{t-2}	-0.54 (-0.53)	-0.89 (-0.90)	-	-
ΔlnP_{t-3}	1.39* (1.83)	0.93 (0.92)	-	-
ΔlnP_{t-4}	-	1.53** (2.06)	-	-
$\Delta lnER_t$	-0.16 (-1.47)	-	-0.15 (-1.54)	-
$\Delta lnER\_POS_t$	-	-0.22** (-2.10)	-	-0.25** (-2.58)
$\Delta lnER\_NEG_t$	-	1.19*** (3.86)	-	-0.03 (-0.30)
$\Delta D8$	0.21*** (4.59)	0.19*** (4.66)	0.08*** (3.13)	0.19*** (5.13)

Table 4.24: Other Manufacture (X=lnXOM) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	2.15** (2.02)	1.53*** (4.54)	-1.08* (-1.84)	0.56 (0.86)
lnP_t	0.42 (0.62)	-0.95*** (-4.10)	-	-
$lnER_t$	-0.79 (-1.54)	-	-0.50 (-1.65)	-
$lnER\_POS_t$	-	-0.42** (-2.26)	-	-0.80*** (-2.66)
$lnER\_NEG_t$	-	2.21*** (4.66)	-	-0.09 (-0.31)
D8	1.02*** (2.90)	0.36*** (3.94)	0.29*** (4.47)	0.60*** (5.08)
Constant	5.47 (1.01)	5.79*** (3.62)	19.68*** (6.22)	9.78*** (3.22)
	Panel C: Diagnostic Tests			
LM-1 lag	0.72 [0.40]	0.27 [0.61]	3.76 [0.05]	1.13 [0.29]
LM-12 lag	20.44 [0.06]	15.54 [0.21]	18.82 [0.09]	10.51 [0.57]
ARCH-1 lag	0.04 [0.83]	0.94 [0.33]	0.33 [0.56]	0.01 [0.93
ARCH-12 lag	12.37 [0.41]	12.98 [0.37]	16.53 [0.17]	10.73 [0.55]
Jarque Bera	0.37 [0.83]	0.33 [0.85]	0.19 [0.91]	1.24 [0.54]
ECM (-1)	-0.20*** (-3.03)	-0.54*** (-6.22)	-0.29*** (-4.50)	-0.31*** (-4.86)
Wald	-	21.70 {1,172} [0.00]	-	13.95 {1,153} [0.00]
CS (CS-SQ)	S(S)	S(S)	S(US)	S(S)
RESET	0.02 {1,163} [0.89]	0.18 {1,171} [0.67]	0.01 {1,156} [0.90]	0.14 {1,152} [0.71]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

For the XOM, the ER in short run is negatively significant in the RER_NARDL model, mixed in the NER_NARDL and insignificant in the ARDL models. The Wald diagnostic test on the asymmetry of ER behavior conforms asymmetric behavior in RER and NER NARDL models. For the NER_NARDL the ER_POS is negatively significant and ER_NEG is positively significant. For the RER_NARDL both the ER_POS and ER_NEG are negatively significant.

The lags of the dependent variable have negatively significant coefficients for the RER_NARDL model and all others show mixed significant coefficients. Similarly, in the short run the Y coefficients are mixed significant however in the long run they are positively significant for the NER model and negatively significant for the RER_ARDL model. The price coefficients of XOM for the NER_NARDL is negatively significant and

insignificant for the ARDL model of the same. Furthermore, the GFC2007-8 has also a significant positive impact on the XOM export category.

The ECM coefficient is negatively significant for all the four models, implying the ability of the system to return to long run equilibrium in the aftermath of a shock in economy. The diagnostic stats for the LM, ARCH and JB are normal. The CUSUM and CUSUM Square are found to be stable for almost all the models. Accordingly, the RESET stats show error free model specification for XPT category of the export from Pakistan.

5. Export – All Other Group (XAO)

The Export All Other group (XAO) consists of the Pakistani exports which not have been categories elsewhere. These are discussed as below.

Table 4.25: All Others (X=XAO)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	3,5,0,0	3,5,0,0,0	3,5,0	3,5,0,0
Lags	5	5	5	5
$\Delta lnX_{i,t-1}$	-0.48*** (-5.54)	-0.28*(-2.88)	-0.49*** (-5.72)	-0.49*** (-5.70)
$\Delta lnX_{i,t-2}$	-0.25*** (-3.54)	-0.16** (-2.17)	-0.26*** (-3.64)	-0.26*** (-3.63)
$\Delta lnY_{f,t}$	2.79*** (2.85)	3.34*** (0.13)	2.94*** (3.05)	2.86*** (2.89)
$\Delta lnY_{f,t-1}$	0.14 (0.11)	0.15 (0.13)	0.15 (0.12)	0.14 (0.12)
$\Delta lnY_{f,t-2}$	0.14 (0.12)	0.21 (0.85)	0.16 (0.14)	0.15 (0.13)
$\Delta lnY_{f,t-3}$	-0.44 (-0.40)	-0.23 (-0.22)	-0.46 (-0.42)	-0.46 (0.68)
$\Delta lnY_{f,t-4}$	2.20** (2.32)	2.23** (2.45)	2.20** (2.33)	2.20** (2.32)
ΔlnP_t	-0.19 (-0.98)	-1.11*** (-3.62)	-	-
$\Delta lnER_t$	-0.10 (-0.55)	-	-0.13 (-0.72)	-
$\Delta lnER\_POS_t$	-	-0.18 (-1.00)	-	-0.11 (-0.59)
$\Delta lnER\_NEG_t$	-	1.94*** (3.40)	-	-0.15 (-0.78)
ΔD8	0.26*** (2.98)	0.27*** (3.21)	0.30*** (3.94)	0.28*** (3.24)

Table 4.25: All Others (X=XAO) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	-0.24 (-0.28)	0.79 (1.62)	0.17 (0.25)	-0.05 (-0.05)
lnP_t	-0.48 (-1.02)	-1.62*** (-4.90)	-0.35 (-0.74)	-
$lnER_t$	-0.26 (-0.56)	-	-	-
$lnER\_POS_t$	-	-0.27 (-1.02)	-	-0.30 (-0.60)
$lnER\_NEG_t$	-	2.84*** (4.28)	-	-0.39 (0.43)
D8	0.66*** (3.82)	0.40*** (3.63)	0.78*** (7.93)	0.74*** (4.74)
Constant	13.14*** (2.95)	7.85*** (3.43)	11.53*** (2.78)	10.92 (0.02)
	Panel C: Diagnostic Tests			
LM-1 lag	0.00 [0.98]	0.03 [0.86]	0.02 {0.89]	0.01 [0.93]
LM-12 lag	18.94 [0.09]	18.17 [0.11]	19.23 [0.08]	19.72 [0.07]
ARCH-1 lag	0.57 [0.45]	0.14 [0.71]	0.49 [0.48]	0.51 [0.47]
ARCH-12 lag	3.65 [0.99]	2.81 [1.00]	3.46 [0.99]	3.52 [0.99]
Jarque Bera	79.85 [0.00]	118.36 [0.00]	81.36 [0.00]	80.87 [0.00]
ECM (-1)	-0.39*** (-4.73)	-0.68*** (-6.15)	-0.38*** (-4.66)	-0.38*** (-4.66)
Wald	-	14.27 {1,175} [0.00]	-	0.09 {1,176} [0.76]
CS (CS-SQ)	US(US)	US(S)	S(US)	US(US)
RESET	0.82 {1,175} [0.37]	3.12 {1,174} [0.08]	0.47 {1,176} [0.50]	0.59 {1,175} [0.44]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

The ER is only negatively significant in case of NER_NARDL estimation model. Apart from this model, the coefficients of the ER variable are insignificant. Wald test stats show that the ER behaves asymmetrically in case of NER but symmetrically in case of RER.
The coefficients of the lagged XAO are mixed in significance nature. However the world income has positively significant coefficients in the short run and insignificant in the long run. Price co08efficients are only significant in the NER_NARDL model of the XAO estimation. Further, the D8 dummy coefficients related to GFC 2007-8 positively are positively significant.

The ECM coefficient is negatively significant for all the four models, implying the ability of the system to return to long run equilibrium after a shock in economy. The diagnostic stats for the LM and ARCH are normal. However, the data sample does not comply with the normality assumptions. The CUSUM and CUSUM Square are found to be unstable for

these models with only two exception. Accordingly, the RESET stats show error free model specification for XAO category of the export from Pakistan.

6. Export – Total Export Receipts Through Banks (XGT)

This is the sum of all the categories. The Export Receipts Through Bank or Grand total of Exports (XTG) sum up the money value of all the goods exported by Pakistan. The estimated results and analysis is given below.

Table 4.26: Total Exports (X=XGT)

	N-ER		**R-ER**	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel A: Short Run Estimates			
Model	12,12,2,0	12,12,4,0,0	9,8,0	9,8,0,0
Lags	12	12	9	9
$\Delta lnX_{i,t-1}$	-0.64*** (-7.13)	-0.57*** (-5.29)	-0.56*** (-6.44)	-0.57*** (-6.50)
$\Delta lnX_{i,t-2}$	-0.25** (-2.50)	-0.20* (-1.81)	-0.14 (-1.49)	-0.16 (-1.63)
$\Delta lnX_{i,t-3}$	0.17* (1.68)	0.23** (1.99)	0.33*** (3.52)	0.31*** (3.21)
$\Delta lnX_{i,t-4}$	0.07 (0.70)	0.14 (1.28)	0.14 (1.48)	0.12 (1.26)
$\Delta lnX_{i,t-5}$	-0.16 (-1.58)	-0.07 (-0.67)	-0.17* (-1.82)	-0.19* (-1.97)
$\Delta lnX_{i,t-6}$	-0.27*** (-2.78)	-0.19* (-1.83)	-0.29*** (-3.13)	-0.31*** (-3.24)
$\Delta lnX_{i,t-7}$	-0.31*** (-3.21)	-0.25** (-2.43)	-0.37*** (-4.00)	-0.38*** (-4.10)
$\Delta lnX_{i,t-8}$	-0.23** (-2.26)	-0.17 (-1.64)	-0.22*** (-2.93)	-0.22*** (-3.02)
$\Delta lnX_{i,t-9}$	-0.18* (-1.73)	-0.13 (-1.19)	-	-
$\Delta lnX_{i,t-10}$	-0.31*** (-3.17)	-0.27*** (-2.69)	-	-
$\Delta lnX_{i,t-11}$	-0.26*** (-3.43)	-0.245*** (-3.18)	-	-
$\Delta lnY_{f,t}$	0.35 (0.71)	0.32 (0.64)	0.31 (0.70)	0.42 (0.93)
$\Delta lnY_{f,t-1}$	-0.96* (-1.75)	-0.98* (-1.79)	-0.97* (-82)	-0.95* (-1.79)
$\Delta lnY_{f,t-2}$	0.32 (0.58)	0.21 (0.39)	0.12 (0.23)	0.12 (0.24)
$\Delta lnY_{f,t-3}$	0.05 (0.08)	-0.03 (-0.05)	-0.30 (-0.59)	-0.30 (-0.58)
$\Delta lnY_{f,t-4}$	0.19 (0.36)	0.23 (0.43)	0.66 (1.30)	0.69 (1.34)
$\Delta lnY_{f,t-5}$	0.16 (0.30)	0.19 (0.36)	0.26 (0.50)	0.31 (0.59)
$\Delta lnY_{f,t-6}$	-0.77 (-1.44)	-0.80 (-1.50)	-1.04** (-2.19)	-1.02** (-2.15)
$\Delta lnY_{f,t-7}$	0.36 (0.67)	0.41 (0.76)	1.10*** (2.68)	1.04** (2.50)
$\Delta lnY_{f,t-8}$	-0.48 (-0.91)	-0.47 (-0.88)	-	-
$\Delta lnY_{f,t-9}$	-0.46 (-0.87)	-0.54 (-1.04)	-	-
$\Delta lnY_{f,t-10}$	0.81 (1.58)	0.76 (1.49)	-	-
$\Delta lnY_{f,t-11}$	0.89** (1.98)	0.86* (1.93)	-	-
ΔlnP_t	0.78 (1.36)	0.79 (1.34)	-	-
ΔlnP_{t-1}	1.27** (2.32)	0.79 (1.07)	-	-
ΔlnP_{t-2}	-	0.05 (0.06)	-	-
ΔlnP_{t-3}	-	0.77 (1.33)	-	-
$\Delta lnER_t$	-0.02 (-0.32)	-	-0.09 (-1.17)	-
$\Delta lnER\_POS_t$	-	-0.02 (-0.25)	-	-0.11 (-1.34)
$\Delta lnER\_NEG_t$	-	0.39 (1.49)	-	-0.07 (-0.78)
ΔD8	0.13*** (4.03)	0.14*** (-0.25)	0.06** (2.40)	0.08** (2.51)

Table 4.26: Total Exports (X=lnXGT) Cont….

	N-ER		R-ER	
	ARDL	**NARDL**	**ARDL**	**NARDL**
	Panel B: Long Run Estimates			
lnY_t	-0.06 (-0.09)	0.61 (1.20)	0.18 (0.31)	0.66 (0.85)
lnP_t	0.23 (0.54)	-0.27 (-0.63)	-	-
$lnER_t$	-0.11 (-0.33)	-	-0.44 (-1.25)	-
$lnER\_POS_t$	-	-0.06 (-0.26)	-	-0.54 (-1.39)
$lnER\_NEG_t$	-	1.168* (1.89)	-	-0.33 (-0.84)
D8	0.58*** (3.26)	0.43*** (2.78)	0.30*** (4.07)	0.39*** (3.04)
Constant	14.73*** (4.60)	11.43*** (4.90)	15.26*** (4.63)	10.98*** (3.01)
	Panel C: Diagnostic Tests			
LM-1 lag	3.11 [0.07]	3.32 [0.07]	0.04 [0.85]	0.04 [0.85]
LM-12 lag	10.45 [0.58]	10.49 [0.57]	19.52 [0.08]	19.66 [0.07]
ARCH-1 lag	1.10 [0.30]	1.25 [0.26]	0.02 [0.90]	0.00 [0.96]
ARCH-12 lag	8.72 [0.73]	10.67 [0.56]	6.69 [0.88]	5.73 [0.92]
Jarque Bera	0.71 [0.70]	0.99 [0.61]	0.79 [0.67]	1.28 [0.53]
ECM (-1)	-0.23*** (-3.44)	-0.33*** (-3.38)	-0.21*** (-3.45)	-0.20*** (-3.23)
Wald	-	2.32 {1,148} [0.13]	-	0.80 {1,163} [0.37]
CS (CS-SQ)	S(S)	S(S)	S(S)	S(S)
RESET	0.22 {1,150} [0.64]	0.04 {1,147} [0.84]	0.04 {1,163} [0.85]	0.12 {1,162} [0.72]
S = Stable; US = Unstable; ( ) = T-Values; { } = Degree of freedom; [ ] = P-Values				
***** Significant at 1%; ** Significant at 5%; * Significant at 10%**				

It is advocated by policy makers, the devaluation would promote the exports of the country. However, this claim does not seem to be fulfilled here in Pakistan. The estimated coefficients of the ER in long run as well as short run do not have significant coefficients for all the four models except positively significant ER_NEG coefficient for the NER_NARDL model. And even the significant coefficient states that the stronger the PKR, the more it would promote exports of Pakistan. Also the Wald test on the ER coefficient symmetry estimates that the ER behavior for the XGT is symmetric. Therefore, it comes to conclusion that the depreciation of PKR does not support the Export Growth of Pakistan.

The lagged value coefficients of the XGT are mixed in nature and may not form a uniform conclusion on the XGT dependence on its lags. Similar is the case of world income in the short run. However, in the long run the Y_f is insignificant in determining the XGT level for the current period. Price is positively significant in the short run, but not in the long run. This means that when relative price increase, it does increase Pakistan's exports in the short

run, but it has no impact on the Pakistani exports in the long run. However, the estimations show that the D8 has positive and significant coefficient in the short as well as long run. The ECM is negatively significant, indicating that they system would revert to the long run equilibrium after it faces an external shock. The LM and, ARCH results are normal and also the JB indicates the normality of the sample data. The CUSUM and CUSUM Square indicate the stability of the coefficients in all the four models. RESET stats also indicate that the model are well specified.

Empirical evidence from other researches on exports and exchange rate: Overall, In case of linear ARDL model, all the models for exports in this study show that real exchange rate and nominal exchange rate have insignificant effects on exports except on industrial exports while foreign income also has insignificant effects on the exports except in case of industrial exports. As for as the findings of non-linear ARDL models for imports are concerned, the most of the export models show that appreciation of exchange rate determine the exports of different industries positively while in some models, depreciation of exchange rate is found insignificant. The results of this study are supported by some of the latest existing empirical studies (Bahmani-Oskooee et. al, 2020; Bahmani-Oskooee & Fariditavana 2015; Lossifov and Fei, 2019).

C. The Nominal Exchange Rate (NER) or the Real Exchange Rate (RER)?

One of the objective of the study is to check the usability of the NER or RER as exchange rate determinant measure of Pakistan's foreign trade. In order to respond to this specific objective, the effect of NER and RER on the import and export of Pakistan are compared and contrasted in the following table.

Table 4.27: Exchange Rate Summary Table for Imports

		Nominal Exchange Rate			**Real Exchange Rate**		
Imports	**Short / Long Run**	**ARDL**	**NARDL**		**ARDL**	**NARDL**	
-	**-**	**-**	**ER-POS**	**ER-NEG**	**-**	**ER-POS**	**ER-NEG**
lnMAO	**Short**	S	IS	IS	M	IS	M
	Long	IS	IS	IS	IS	S	IS
lnMCG	**Short**	S	IS	IS	S	S	S
	Long	S	S	IS	IS	S	S
lnMFO	**Short**	IS	S	S	IS	S	S
	Long	S	S	IS	S	S	S
lnMGT	**Short**	S	S	IS	S	S	S
	Long	S	S	IS	S	S	S
lnMMG	**Short**	IS	IS	S	IS	IS	IS
	Long	IS	IS	S	IS	NA	NA
lnMMI	**Short**	S	S	S	S	S	IS
	Long	S	S	S	S	S	S
lnMMT	**Short**	IS	S	S	IS	IS	IS
	Long	IS	IS	S	IS	IS	IS
lnMPT	**Short**	M	M	S	M	S	S
	Long	NA	S	S	IS	NA	NA
lnMTG	**Short**	S	S	IS	IS	S	IS
	Long	IS	IS	IS	S	S	S
lnMTX	**Short**	IS	IS	IS	S	IS	S
	Long	IS	IS	IS	S	IS	S
S = Significant; IS = Insignificant; M = Mixed NA = Not Applicable							

The table has been extracted from the main estimations of this study. However, these have been modified and presented in a way to serve the specific objective of comparing the NER and RER.

MAO: By looking at the table of exchange rate summary for the imports, in the first variable MAO, the NER gives clear cut response as the ER being significant or

insignificant, whereas the RER has mixed results in short run. Therefore both the approaches may give almost comparable results however, NER being more preferable.

MCG: The results of the NER has less significant coefficients whereas the RER has more of the same. In this case the RER seems to be appropriate measure with respect to the ER effectiveness.

MFO: In this category, the NER and RER both give almost matching results. Therefore any of the ER can be used for the analysis.

MGT: in this category the RER has all the related coefficients being significant. On the other hand, the NER has insignificant ER_NEG coefficients. Overall, any of the two ER approaches seem to be equally good.

MMG: For this variable, both NER and RER seem to be ineffective, as the coefficients are either insignificant or there is no long run relationship established. However, the NER has ER_NEG significant coefficients. So almost similar effectiveness can be deduced by this observation.

MMI: Again for this variable the NER and RER seem to be equally good determinants for ARDL and NARDL modeling.

MMT: The import category of MMT makes it clear that the RER coefficients are insignificant in all the cases under-consideration. However the NER has some coefficients being significant for the NARDL model. Therefore the NER might be more useful for this group's analysis.

MPT: For this category of imports, both NER and RER give mixed results. Therefore no clear-cut distinction be made on the feasibility of either of the ER approaches to be used.

MTG: In this category, the RER has most coefficients being significant. That means The RER may better be used to detect the relationship between ER and this category of imports.

MTX: In this category of imports, the NER fails to detect any relationship between ER and the MTX. However, most of the coefficients are significant in case of RER. Therefore Overall RER may be called a better determinant of the MTX imports.

Table 4.28: Exchange Rate Summary Table for Exports

		Nominal Exchange Rate			Real Exchange Rate		
Exports	**Short / Long Run**	**ARDL**	**NARDL**		**ARDL**	**NARDL**	
-	-	-	**ER-POS**	**ER-NEG**	-	**ER-POS**	**ER-NEG**
lnXAO	**Short**	IS	IS	S	IS	IS	IS
	Long	IS	IS	S	IS	IS	IS
lnXFO	**Short**	IS	IS	IS	IS	IS	IS
	Long	IS	IS	IS	IS	IS	IS
lnXGT	**Short**	IS	IS	IS	IS	IS	IS
	Long	IS	IS	S	IS	IS	IS
lnXOM	**Short**	IS	S	S	IS	S	IS
	Long	IS	S	S	IS	S	IS
lnXPT	**Short**	M	M	IS	S	IS	IS
	Long	IS	IS	IS	IS	IS	S
lnXTX	**Short**	IS	S	S	IS	IS	S
	Long	S	S	S	S	S	S
S = Significant; IS = Insignificant; M = Mixed NA = Not Applicable							

XAO: In this category of the exports, only coefficients for ER_NEG of the NER is significant, apart from that all the other being insignificant. It can be concluded that NER may be better determinant of XAO export category.

XFO: Both, the NER and RER coefficients are insignificant in all the ARDL and NARDL models.

XGT: Again for the total exports of Pakistan NER and RER coefficients are insignificant in all the ARDL and NARDL models. This implies that ER does not play any role in determining the exports of the country.

XOM: the ARDL models for NER and RER have insignificant in this category analysis. However, all the coefficients of NER_ARDL are significant, whereas only ER_POS coefficients are significant for the RER_NARDL. Therefore both the measures of ER are almost similar in determining fate of the XOM exports.

XPT: In this category the NER does not give any clear result for two coefficients and insignificant for other four coefficients. However, the RER is clearer in having two

significant and remaining coefficients being insignificant. So the RER seems to be better measure as compared to NER.

XTX: For textile exports almost all the coefficients of NER and RER seem to be significant. Hence, any measure can be used to study the impact of the ER on XTX.

Nonlinearity of Exchange Rate: Nonlinearity being the second objective of the study, following table has the Wald test results. The null for Wald test is the restriction is valid. And when the null is rejected, the applied restriction is invalid. For this study's Wald test tests the condition ER_POS coefficients being equal to that of ER_NEG. The results of these tests are as follows for import and export separately. Followed by the summary table if there exists symmetry in the ER behavior that is if the exchange rate appreciation and depreciation coefficients are same or different.

Table 4.29: Wald Test Results for NARDL

Variable	Nominal Exchange Rate	Real Exchange Rate
	Imports	
lnMAO	2.21 {1,176} [0.14]	5.89 {1,178} [0.02]
lnMCG	1.13 {1,179} [0.29]	2.67 {1,166} [0.10]
lnMFO	5.17 {1,178} [0.02]	1.43 {1,180} [0.23]
lnMGT	0.87 {1,178} [0.35]	1.19 {1,178} [0.28]
lnMMG	9.61 {1,177} [0.00]	1.98 {1,178} [0.16]
lnMMI	0.07 {1,185} [0.80]	2.27 {1,183} [0.13]
lnMMT	0.53 {1,171} [0.47]	0.26 {1,182} [0.61]
lnMPT	0.70 {1,177} [0.40]	0.01 {1,177} [0.93]
lnMTG	1.90 {1,175} [0.17]	1.80 {1,181} [0.18]
lnMTX	1.18 {1,181} [0.29]	14.73 {1,182} [0.00]
	Exports	
lnXAO	14.27 {1,175} [0.00]	0.09 {1,176} [0.76]
lnXFO	0.21 {1,153} [0.65]	0.59 {1,154} [0.44]
lnXGT	2.32 {1,148} [0.13]	0.80 {1,163} [0.37]
lnXOM	21.70 {1,172} [0.00]	13.95 {1,153} [0.00]
lnXPT	0.55 {1,181} [0.46]	1.34 {1,182} [0.25]
lnXTX	10.46 {1,168} [0.00]	4.35 {1,159} [0.04]
{ } = Degree of freedom; [ ] = P-Values		

Table below has the summary of the Wald test results.

Table 4.30: Wald Test Results: Exchange rate is symmetrical

Variable	Nominal Exchange Rate NARDL	Real Exchange Rate NARDL
	Imports	
lnMAO	Yes	No
lnMCG	Yes	Yes
lnMFO	No	Yes
lnMGT	Yes	Yes
lnMMG	No	Yes
lnMMI	Yes	Yes
lnMMT	Yes	Yes
lnMPT	Yes	Yes
lnMTG	Yes	Yes
lnMTX	Yes	No
	Exports	
lnXAO	No	Yes
lnXFO	Yes	Yes
lnXGT	Yes	Yes
lnXOM	No	No
lnXPT	Yes	Yes
lnXTX	No	No

The Above table shows if the ER coefficients are equal in case of when the PKR strengthens or weakens. The "Yes" specifies the symmetric behavior of the ER. Whereas the "No" specifies the existence of asymmetry in the ER_NEG and ER_POS coefficients.

For imports the Wald test has two asymmetric coefficients of ER as determined by the NER being MFO and MMG. On the other hand the RER also reports two categories having asymmetric ER coefficients but the categories are not same in this case. For RER the asymmetric ER coefficients belong to category of MAO and MTX.

In case of Exports, the NER shows that the ER coefficients of XAO, XOM and XTX show asymmetry in the NARDL analysis. Whereas the RER ER coefficients of export show asymmetry in XOM and XTX. These two same coefficients have also been detected for asymmetry by the NER models' Wald tests.

Looking critically, out of 32 case (20 cases of imports and 12 cases of exports), only 7 are validated for the ER asymmetric behavior in case of appreciation and depreciation. In all

the other cases, as per the Wald stats, the exchange rate coefficients are equally god for appreciation as well as depreciation.

D. Marshal Learner Condition for trade balance of Pakistan: Checking for the Marshal Lerner Condition or MLC for the imports and exports. In following section the same has been tested based on the already reported statistics.

According to MLC, if the absolute sum of the export and import elasticities of exchange rate is greater than 1, the trade balance of the country would correct after the country's currency faces a depreciation or devaluation. To test this condition, following table gives the results required.

Table 4.31: Elasticities

	Total Imports	**Total Exports**	**Absolute Sum**	**Meet LMC (Yes / No)**
NER	-1.00	-0.11	1.11	Yes
RER	-0.80	-0.44	1.24	Yes

As per the above table the absolute sum of the imports and exports total category exceeds 1 for both NER as well as RER, making the MLC applicable in case of Pakistan. This imply that Pakistan's trade balance should correct and improve over the post devaluation period. However, the elasticities reported above are described below if they are significant in the analysis or not.

Table 4.32: Elasticities Significance

	Total Imports	**Total Exports**	**Absolute Sum**
NER	S	IS	0
RER	S	IS	0

It is noted in the above table that only import's exchange rate coefficients are significant for both the NER and RER. The coefficients of the export are not significant in NER as well as RER models. Therefore the export's elasticities do not count towards the absolute sum of the elasticities. The table below is adjusted for this arrangement.

Table 4.33: Elasticities after Considering Significance

	Total Imports	**Total Exports**	**Absolute Sum**	**Meet LMC (Yes / No)**
NER	-1	-	1	Yes
RER	-0.8	-	0.8	Yes

In this case only import elasticities are included in the total elasticity calculation. The import elasticity under the NER exchange rate arrangement just equals the unit (1) elasticity. In case of model evaluation using RER, the total elasticity does not exceed 1. In both cases the MLC is not met.

Chapter 5

Conclusion

5.1. Introduction

This is the last section of the study. Here the study's key outcomes, major constrains and recommendations for future studies are discussed.

5.2. Key Findings of the study

Having thoroughly discussed the individual as well as collective results of the estimates, following conclusion can be formed as to present the result of this dissertation in nutshell.

First of all he study establishes that most of the ARDL and NARDL models behave alike towards changes in exchange rate. Only 7 cases out of 32 models conform the existence of the asymmetry of the exchange rate coefficients. This result does not support the point of view of having a distinction between ARDL and NARDL, at least in case of Pakistan for the given data period and sample set. Hence, the exchange rate behavior is symmetric in nature as per its impact on foreign trade.

After evaluating the ARDL as well as NARDL models using nominal and real exchange rates for the same data sample, this study does not find a clear cut distinction and advantage of using one type of exchange rate measure over the other type. This result further conforms to the view point of Katseli (1983) that there is ambiguous relationship between NER and RER.

Finally, the MLC is not met in any of the two cases i.e. nominal exchange rate and real exchange rate. When nominal exchange rate is being used as a measure of exchange rate the individual size of the import elasticity equals the unit or 1. There is no contribution of the export elasticity in the absolute sum of the two elasticities as the export do not show any significant elasticity towards the exchange rate. Therefore the absolute sum of the export and import elasticities remain equal to the unit elasticity.

According to the MLC as tested through nominal exchange rate Pakistan's trade balance would remain at the same level as it had been before depreciation of PKR. However, there

is no contribution of the export rise after the devaluation. Therefore, it may not be right to say that Pakistan's export would surge after the devaluation of PKR. Further, as the export elasticities are insignificant, it may not be appropriate to consider the MLC at first place, as the MLC requires the sum of the export and import elasticities, not only one of the two. The anomaly can be due to the Pakistan's heavy dependence on import of necessary goods such as petroleum and others. Therefore it can be concluded that the negative coefficient of the imports shows that the depreciation of the PKR would leads the imports to decline in volume, but the increase in price in terms of PKR would offset the result, leaving the trade balance remain unaltered.

Contrary to the NER and its findings of MLC, the RER has different scenario. The absolute sum of the import and export elasticities is less than 1 ($0.80<1$). This indicates that if RER is considered as a measure of exchange rate Pakistan's already deficit trade balance would further plunge. Hence worsening the condition of Pakistan's economy. This case is aligned with findings of Rehman et al. (2012)and Rehman (2017) and also by the fact that Pakistan has been going deep down into the deficit trade balance despite efforts to correct it through depreciation. Therefore, the RER seems to be close to reality while choosing among the exchange rate measures to study its impact on the Pakistan's trade balance.

5.3. Recommendations and future study prospects

Having sound understanding of the results of this study, it is recommended that Pakistan's rupee may not be allowed to depreciate with a hope to see an improvement in the chronically deficit trade balance. Further, as per this study, there is no impact of exchange rate over export rise, so the same may not be expected to happen after the devaluation in case of Pakistan.

Furthermore this study has good avenues for future research. As a first option, the researchers can go for further descriptive analysis based on this study's estimations. Secondly, as only bound testing is used to establish cointegration and long run relationship between the imports / exports categories and the exchange rate. The long run relationship was not established in the cases where the bound test results were inconclusive. Further study can apply other recommended tools to check if the long run relationship between the

variables can be established. Still further, some of the data samples suffered from ARCH effect which were left unattended in this study. Future researchers can look into gap by doing ARDL with ARCH technique.

5.4. Limitations of the study

Despite the best efforts, there are always limitation for every task accomplished, this study is not an exception. There might be so many limitations this study has faced, but important ones have been mentioned as under.

Using industrial production as a proxy for the GDP / national income is one of the major limitations of this study. Monthly data is used for Pakistan and rest of the world, however Pakistan does not have monthly GDP officially issued. Therefore the results may not be as accurate as they ought to be.

Secondly the United States' industrial production is used as a proxy for rest of the world national income. And the PKR to USD is used as a measure of exchange rate. The study results would have improved if actually national income of all the trade partner countries were used and the exchange rates were calculated accordingly as per the trade weightage i.e. effective exchange rates. Or at least the industrial production of all the trading partners were used. Here the issue was that all the trading partner countries of Pakistan do not have industrial production or GDP data or they do not maintain it on monthly basis.

These two major limitations might have actually undermined the results of this study. They would have higher level of accuracy otherwise.

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Appendix A

Figure 1: Yearly Trade Data

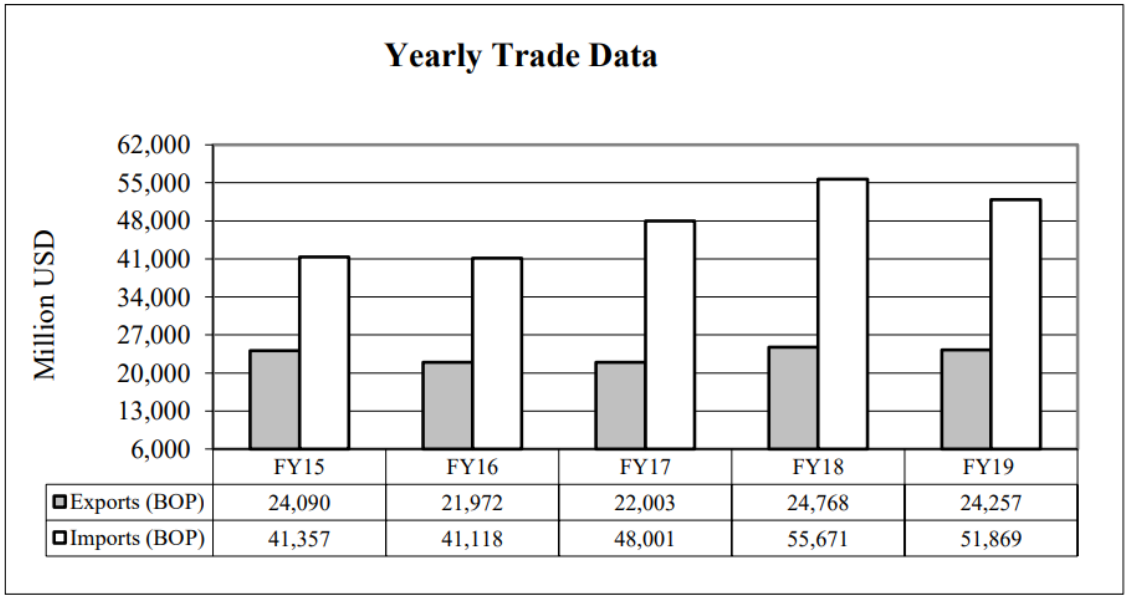

Figure 2: Monthly Trade Data

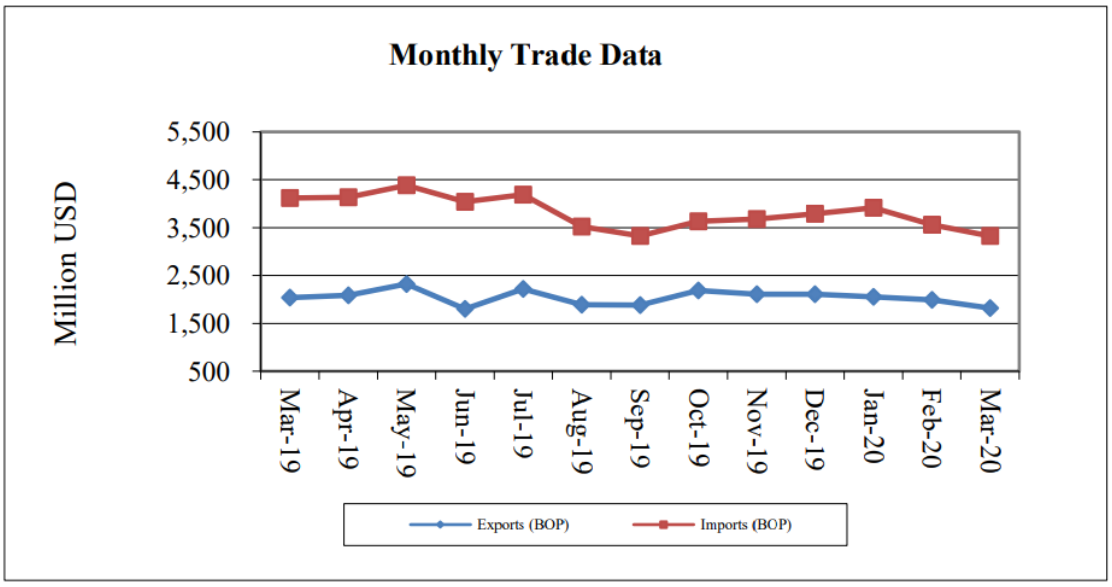

Figure 3: Nominal Exchange Rate

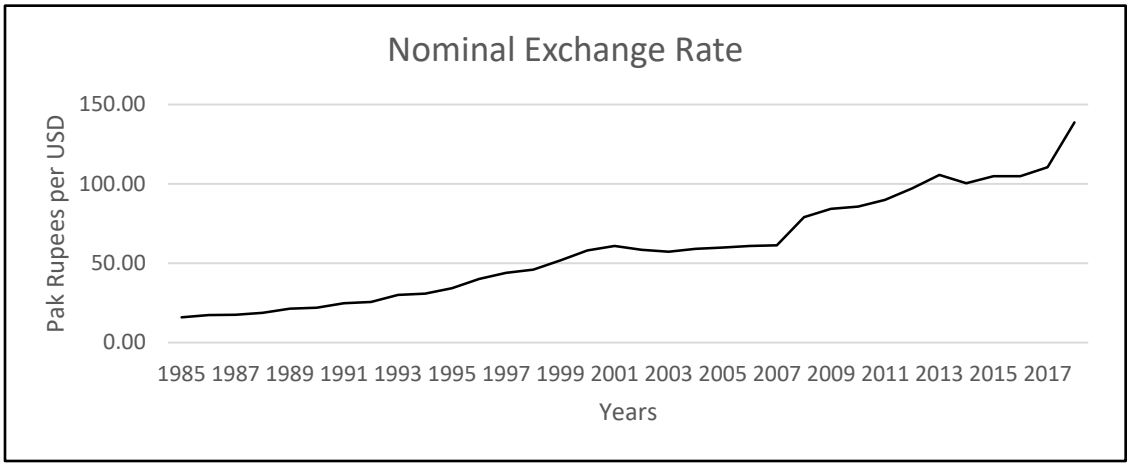

Figure 4: Pakistan's Imports and Exports

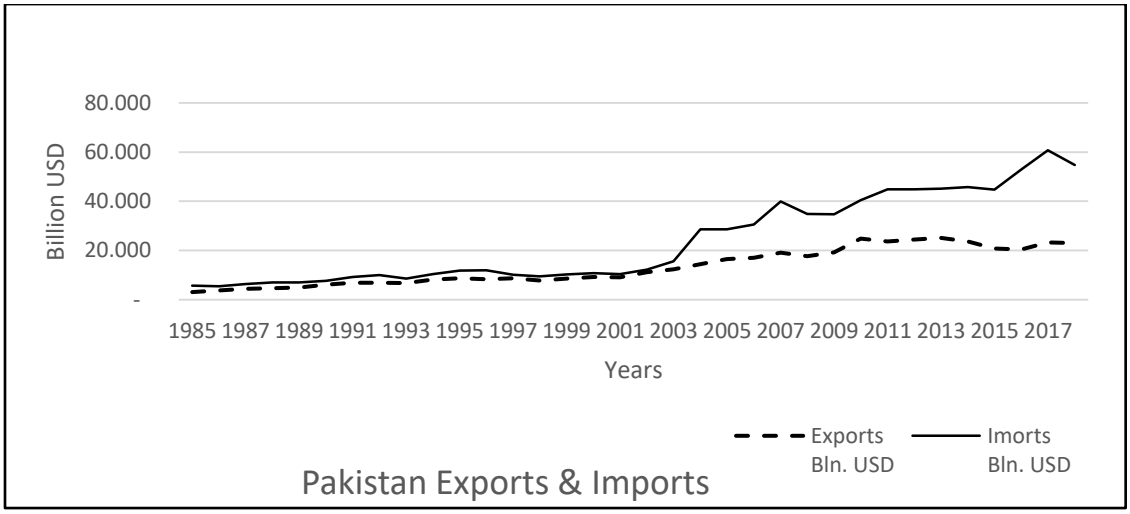

Figure 5: Pakistan's Trade Balance