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Exchange Rate Volatility and Pakistan Trade Flows: New Evidence of Symmetric and Asymmetric Effect

by

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Dedicated to my lovely parents and my siblings who always encourage and support me. My relatives, friends and my special friend Zahir Ahmed, he always encourage me for my academic goal

CERTIFICATE OF APPROVAL

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Abstract

The objective of this study is to assess and compare the short-term and long-term symmetric and asymmetric effect of exchange rate volatility on Pakistan aggregate and industry-level disaggregated trade flows. Using quarterly data from Q3-2003 to Q2-2018, the Pesaran et al. (2001) linear and Shin et al. (2014) nonlinear approach is applied. There is significant short-term and long-term symmetric effect of exchange rate volatility in almost $2/3^{rd}$ of exporting and importing industries of Pakistan. Further, short-run effect, short-run adjustment, short-run cumulative effect is found asymmetric in aggregate trade, export, import, and in importing and exporting industries. Likewise, the long-run effect, and long-run adjustment is observed asymmetric. The exchange rate volatility affect trade flows of some industries adversely and others favorably both in the short-run and long-run, indicating the effect is industry specific due to diversified exposure of industries to exchange rate risk.

Keywords: Exchange Rate Volatility, Trade Flows, Symmetric Effect, Asymmetric Effect

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Abbreviations

ARDL	Autoregressive Distributed Lag
NARDL	Nonlinear Autoregressive distributed lag
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
ARCH	Autoregressive Conditional Heterosce0dasticity
RESET	Regression Equation Specification Error
REER	Real Effective Exchange Rate
CUMQ	Cumulative Sum of Square
CUM	Cumulative Sum
ADF	Augmented Dickey Fuller Test
PP	Phillip Perron Test
Adj. R^2	Adjusted R-Square
LM	Lagrange Multiplier
ECM	Error Correction Model
FDI	Foreign Direct Investment
IP	Industrial Production
IR	Interest Rate
RT	Remittances
INF	Inflation
V	Volatility

Chapter 1

Introduction

After the end of Bretton wood exchange rate system in 1973 the free-floating exchange rate, the rate determined by the forces of supply and demand, begin which develop an interest in the area of many researchers to investigate, theoretically and empirically, the impact of exchange rate volatility on the world trade flows. There are two channels, direct and indirect, through which the change in exchange rate affect domestic prices. Under the direct channel, a fall in exchange rate leads to increase in imports as well as increase the prices of inputs in domestic currency. Secondly, under the indirect channel, a decline in the exchange rate trigger to the availability of domestic goods to foreign buyers at a cheaper rate, and the demand for domestic products increased. Thus the change in exchange rate effect trade flows either positively or negatively. Many developed and emerging countries focused on the stability of exchange rate volatility to protect themselves from the fluctuations. For instance, to maintain its competitiveness China followed manage float system. Similarly, the adoption of one currency, Euro, by European Union is the evidence to mitigate the effect of exchange rate volatility on member countries bilateral trade. The intervention of country central bank in the currency market to stabilize exchange rate volatility is another eventually followed in developing countries.

1.1 Background of the Study

Exchange rate volatility defined as the persistent fluctuations of exchange rate got broader focus in recent studies due to its major effect on developing economies. Developing as well as developed economies are confronted with volatility of exchange rates and its major impact on exports (Arize et al., 2000; Bahmani-Oskooee and Hegerty, 2007; Wang and Barrett, 2007; Vieira and MacDonald, 2016), volume of country investments (Kiyota and Urata, 2004), growth of employment in country (Belke and Setzer, 2003; Belke and Kaas, 2004), leads to higher inflation (Bobai et al., 2013), output growth rate (Levy-Yeyati and Sturzenegger, 2003; Danne, 2006; Holland et al., 2011), on international trade (Doyle, 2001; Bredin et al., 2003; Musila and Al-Zyoud, 2012) and more specifically on the economic activity in country (Kandil et al., 2004; Adewuyi and Akpokodje, 2013).

The available literature on exchange rate volatility and trade flows (imports and exports) does not provide clear conclusion that whether the impact of exchange rate volatility is positive, negative or both.

In the empirical findings of previous studies, the net effect of exchange rate volatility on trade flows is inconsistent. The first strand reports a positive impact of exchange rate volatility on international trade flows (Asseery and Peel, 1991; Franke, 1991; Broll and Eckwert, 1999; Sercu and Uppal, 2003). Secondly, the findings of Ethier (1973); Doğanlar (2002) and Clark (1973) reported a significant negative impact of exchange rate volatility on trade flows. Thirdly, other studies of Cushman (1986), Dellas and Zilberfarb (1993) and Perée and Steinherr (1989) results conclude that there is no link in exchange rate volatility and international trade. So the association of exchange rate volatility and international trade is still inconclusive. There are many reasons for this inconclusiveness in the literature.

Theoretically, the inconclusiveness is due to the different risk attitude of international traders. Some are risk-averse while some are risk loving. Risk-averse traders substitute international trade with domestic trade to avoid exchange rate volatility. While risk loving increase international trade to earn more profit as compensation in case of the favourable effect of exchange rate volatility on trade

flows (De Grauwe, 1988). On the other hand, the findings of Sercu and Vanhulle (1992) argue that higher volatility of exchange rate creates opportunities of higher profit making for the risk-neutral investors to earn more in the highly volatile period. Forward markets reduce the volatility influence (Caporale and Doroodian, 1994) but does not available in Pakistan and further not affordable for small firms (Wei, 1999). Empirically, some recent studies conclude that the indeterminate results of past studies are due to the over-reliance on aggregated trade flows and weak econometric techniques (Bahmani-Oskooee and Harvey, 2011; Baek, 2013; Bahmani-Oskooee et al., 2013a).

Willett (1986) studied the effect of exchange rate volatility at the industry level, findings show that the association is different from industry to industry and does not show unidirectional impact. In his study, he finds for some industries the affect of volatility positive and for other negatives, and for some not found any relationship. Other studies (Bacchetta and Van Wincoop, 2000; Dhanani and Groves, 2001; Barkoulas et al., 2002) supported this view. After the mixed findings of previous studies the work of McKenzie (1999) and Bahmani-Oskooee and Hegerty (2007) argue that the effect of exchange rate volatility on trade is neither entirely significant nor completely unidirectional, differ for the horizon of study and the market of interest and thus require more disaggregated trade data for future research.

The relationship between exchange rate volatility and international trade among the nations has been studied through various approaches empirically. The extant literature falls into any of the following three strands. First, earlier studies (Bahmani-Oskooee, 1986; Felrningham, 1988; Mahdavi and Sohrabian, 1993) applied aggregated trade data of a country with the remaining world. The results of these studies are mixed. Second, due to the problem of aggregation bias, later studies disaggregate data at the bilateral level (Arora et al., 2003; Bahmani-Oskooee and Ratha, 2004; Wilson, 2001). These studies conclude that the trade of a country may worsen with some of its partners, while simultaneously enhance with remaining partners, the focal point of these studies is that earlier studies are affected from the aggregation bias. The aggregated data findings are overgeneralised

(due to aggregation bias) and inappropriate to interpret the particular behaviour and risk profile of the individual industry and the different nature of each trading partner trade ties. These aggregation in data cut-off the opposite effect of the various industries of a country as well as the different nature of trading partner and trade agreements with that partner. So such studies findings are misleading and not appropriate to devise exchange rate and international trade policies with respect to the particular trading partner and industry of interest. The third flow of recent studies took imports and exports separately to overcome the problem of aggregation bias, these studies disaggregate data not only just at a country level but also at the industry level and even some at the product level.

On the econometric side, previous studies used various analysis techniques that recent studies conclude inappropriate. These studies used analysis techniques that do not account for the mixed integration cases. It is a known norm in the trade demand model that exchange rate volatility follows level stationary I (0) while other variables in models are first-difference stationary I (1) (Bahmani-Oskooee and Hegerty, 2007). The above-discussed issues lead to inappropriate discussions and misleading policy recommendations.

Due to mixed and inappropriate findings of previous studies recent studies used disaggregated trade data for each trading partner and industry level to conclude more accurate results and policy recommendations for each trading partner and industry in concern. The study of Baek (2013) explore the bilateral industry trade flows between Korea and China, Bahmani-Oskooee et al. (2013a) looks into bilateral trade between US and Brazil, Nishimura and Hirayama (2013) examine the pre and post free exchange rate regime reforms and bilateral industry trade between China and Japan, Bahmani-Oskooee et al. (2013b) looks into the bilateral trade flows between USA and France, another study by Bahmani-Oskooee et al. (2015) investigate the bilateral trade between Egypt and European Union, similarly another study by Hooy et al. (2015) examine the impact of Chinese Yuan volatility on the exports of ASEAN industries disaggregated trade flows to China. An interesting study of Sauer and Bohara (2001) in the panel framework compared the effect of exchange rate volatility on international trade flows of developed and

developing countries. The results of the study provide that exports of developing economies are more sensitive to the volatility of the exchange rate. More precisely two studies of Thorbecke (2008) and Chit et al. (2010) concentrate on Association of East Asian Nations (ASEAN) and conclude that exchange rate volatility decline international trade flows.

A common assumption of all previous studies is that exchange rate volatility effect trade flows in a symmetric way, which means that if a unit increase in exchange rate volatility decreases trade by x percent, then the unit decrease in exchange rate volatility will increase the trade by same x proportion and vice versa. But this study argues that the exchange rate variability has an asymmetric effect on international trade flows. The study of Bahmani-Oskooee and Aftab (2017) shows that prices of trade goods and trade flow response to the volatility of the exchange rate in an asymmetric manner. If trade flows respond in an asymmetric manner then the volume of trade flows should also respond in the same manner. The reason behind this asymmetric response to the volatility could be the expectation and attitude of traders. Like a trader who chose to trade less in response to the increase in volatility may still trade less while the decrease in volatility, this may be due to many reasons like loss of confidence in market, availability of financial managers, and risk tolerance level etc. Conversely let it assume that increased volatility of exchange rate discourage trade flows by 5%, if traders gain confidence on the central bank policies that it will stabilize the exchange rate then he may increase trade by more than 5%, hence there exists asymmetric effect. In addition, it is argued that not only domestic prices respond to exchange rate volatility in an asymmetric manner (Delatte and López-Villavicencio, 2012) but do country import and export (Bussiere, 2013) as well as trade balance that measured by imports and exports (Bahmani-Oskooee and Fariditavana, 2016). Exchange rate volatility effect trade flows in an asymmetric manner both in the short-run and in the long-run (Bahmani-Oskooee and Aftab, 2017). Therefore, in this study, it is argued that exchange rate volatility responds to trade flows both imports and exports in an asymmetric manner.

The exchange rate is the topic of interest for many researchers particularly

in developing countries as it bridges link of a country with rest of the world, as it determines the relative prices and competitive position of a country in the international market (Aliyu, 2010). The topic of exchange rate is a prime interest for those countries who shifted their regime from fix to floating exchange rate system (Arize et al., 2008). Pakistan a developing country after one decade of struggle with fix rate regime decided in 1982 to shift towards floating exchange rate system.

In early 1980s Rupee was linked with US dollar as a anchor currency besides another basket of currencies. After 1982 Pakistani government delinked from US dollar and adopted manage float system to cope with the financial issues resulted from the international trade restrictions. Now Pakistan is following the floating exchange rate system, although there is some intervention from the central bank which is still in debate. Many studies conducted in past concluded that the floating exchange rate system is in the best interest of a country like Pakistan. A renowned study of Husain et al. (2006) on the floating exchange rate regime. His study after examining the determinants concluded that the floating exchange rate is the best solution for Pakistan. Very few studies in past were conducted on the relationship between exchange rate and trade flows. Most of these studies used aggregated date which question the importance of study for individual industry and trading partner, as discussed above.

From a thorough examination of past studies it is evident that no study yet exist that study the relationship between exchange rate volatility and Pakistan disaggregated industry-level both import and export trade flows. Past studies conducted on exchange rate volatility in Pakistan took export trade as an endogenous variable and relative prices, gross domestic product and importers country income as exogenous variables. These studies use techniques like least square regression and panel regression or simple co-integration. Secondly, almost all studies conducted assumed that exchange rate volatility affect trade flows in a symmetric way recently Bahmani-Oskooee and Aftab (2017) propose that prices of trade goods and trade flow response to the volatility of exchange rate in an asymmetric

manner. This phenomenon of asymmetric response will be examined in this study using ARDL nonlinear models of Shin et al. (2014).

This study is novel in many ways, first, little work exists in the literature that study the effect of exchange rate volatility at sectoral-level of trade flows. Second, while all previous studies used aggregate export trade of Pakistan and no study exist that examine the effect of exchange rate volatility on Pakistan import flows. Thirdly, all past studies conducted in Pakistan assumed that exchange rate volatility effect trade flows in a symmetric way. In this study, it is argued that volatility can effect trade flows in an asymmetric way. Fourth, little work conducted in Pakistan that validate the existence of aggregation bias when checking the effect of exchange rate volatility on aggregate trade flows. Fifth, this study takes the current data set for latest time horizon from Q3-2003 to Q2-2018 which improve the best understanding of exchange rate volatility effect on industry-level disaggregated both imports and exports trade flows.

This study compare the short-run and long-run asymmetric and symmetric effect of exchange rate volatility on Pakistan aggregate and industry-level disaggregated trade flows.

1.2 Research Gap

There are various studies that examine the relationship between exchange rate volatility and foreign trade flows (Asseery and Peel, 1991; Broll and Eckwert, 1999; Sercu and Uppal, 2003). But most of these studies used aggregated trade flows which are confronted with the possible aggregation bias that lead to the inconclusiveness of results and misguiding findings when analyzing for different industries and trading partners because of each different risk profile and trading ties. This study will use aggregate as well as industry level disaggregate data for both import and export trade flows to detect that whether there exists the problem of aggregation bias in the context of Pakistan. Secondly, past studies have mixed results regarding the relationship between exchange rate volatility and trade flows (Franke, 1991; Doğanlar, 2002), therefore, this study empirically examine

that whether there is a positive or negative relationship between exchange rate volatility and trade flows. Previous studies assumed that exchange rate volatility effect trade flows in a symmetric way current study argued the asymmetric effect of exchange rate volatility on trade flows which will be tested. Lastly, currently, Pakistani economy is confronted with high volatility of exchange rate thus this study is designed to study the relationship between exchange rate volatility and industry level disaggregated trade flows.

1.3 Problem Statement

The unpredictable changes in exchange rate between the time of contract and final payments increase uncertainty for both importers and exporters (Doğanlar, 2002). As Pakistani currency is highly volatile especially in recent time due to the change of political government and its financial policies. Further Pakistani rupee is depreciating continuously due to the budget deficit, deficit in the balance of trade and the shortage of foreign reserves with the state bank. Pakistani imports in the financial year 2016-2017 were $52,910 million and exports value $20,422 million (Pakistan bureau of statistics). As there exist huge and increasing deficit in the balance of trade the volatility in exchange rate significantly affect these trade flows. In addition due to external debt further Pakistani economy is affected negatively with this high volatility in the exchange rate. Previous studies have mixed results regarding the effect of exchange rate volatility on imports and exports. Some argued that there is a negative effect and some conclude positive effect while another group of studies shows that there is no linkage.McKenzie (1999) and Bahmani-Oskooee and Hegerty (2007) argued that the effect of exchange rate volatility on trade is neither entirely significant nor completely unidirectional, differ for the horizon of study and the market of interest and thus require more disaggregated trade data for future research. Therefore it is vital to study the effect of exchange rate volatility on industry level disaggregated trade flows.

1.4 Research Questions

Research Question 1

Does exchange rate volatility affect Pakistan exports, imports, and aggregate trade flow?

Research Question 2

Whether exchange rate volatility influence, Pakistani imports, exports, and trade flow in short-term and long-term?

Research Question 3

Is the effect of exchange rate volatility on imports and exports industry specific?

Research Question 4

Whether exchange rate volatility influence imports and exports of various sectors in short-term and long-term?

Research Question 5

Is there an asymmetric effect of exchange rate volatility on Pakistani exports, imports, and aggregate trade?

Research Question 6

Does exchange rate volatility has a short-term and long-term asymmetric effect on Pakistani exports, imports, and aggregate trade?

Research Question 7

Is the asymmetric effect of exchange rate uncertainty on Pakistani imports and exports industry specific?

Research Question 8

Is exchange rate volatility has short-term and long-term asymmetric effect on exports and imports of various sectors?

1.5 Research Objectives

The objective of this study is many folds.

Research Objective 1

To empirically investigate the relationship between exchange rate volatility and Pakistan aggregated trade flows.

Research Objective 2

To investigate the effect of exchange rate volatility on Pakistan industry level disaggregated imports and exports.

Research Objective 3

To investigate that whether exchange rate volatility effect trade flows in a symmetric or asymmetric way.

1.6 Significance of the Study

Pakistan is an emerging market its integration is increasing with trading partners particularly China, therefore, the direction of imports and exports is changing. Currently, Pakistan is facing severe problems of currency depreciation and balance of trade, the gap is continuously increasing that push Pakistan into debt burden so Pakistani rupee is becoming unstable especially in recent time. To address such issues there are two solutions either to increase exports or optimize imports. There is a strong connection between currency and import and export. Therefore, the government has to manage exchange rate volatility in the short run and taking measures for long-run to effectively manage trade flows.

Wherever the balance of payment problem arises IMF generally suggest to devalue the currency, a decline in exchange rate trigger to the availability of domestic goods to foreign buyers at cheaper rates thus country exports increased. Conversely, the devaluation of currency leads to an increase in import prices that resulted in the reduction of imports. Thus the country balance of payment bridges. Currently, Pakistan is facing a huge gap in the balance of payment. For this gap to fill Pakistan need financing and IMF recommended the same solution to devalue the currency. Whether historically this strategy to devalue the currency in Pakistan was worked and helpful to increase exports and mitigate imports. Therefore,

this study is designed to examine that whether exchange rate volatility affect trade flows in symmetric or asymmetric way.

The government is to be vigilant because exchange rate volatility affect imports and exports which is further connected with the balance of payment and currency appreciation and depreciation.

The objective of this study is to assess and compare the short-run and long-run asymmetric and symmetric effect of exchange rate volatility on Pakistan aggregated and industry-level disaggregated trade flows. Once the effect of exchange rate volatility is determined the government will be able to devise and implement the financial policies accordingly.

1.7 Plan of Study

This study include five chapters. Chapter 01 is of background of study, problem statement, objective and significance of the study. Chapter 02 is about past literature review and hypothesis of the study. Chapter 03 includes data description, econometric models, and variable descriptions. Chapter 04 consists of empirical results of econometric models. Chapter 05 is about discussions of empirical results, policy implications and future research directions.

Chapter 2

Literature Review

An overview of past literature of exchange rate volatility and trade flows shows that this issue is continuously focus of researchers in past four decades. Early studies in the area like Ethier (1973), Hooper and Kohlhagen (1978), and Broll and Eckwert (1999) shows that higher volatility is connected with higher cost for risk averse traders and reduction in the value of international trade flows. The reason behind this argument is that variation in exchange rate becomes unpredictable which creates uncertainty for the traders to earn profit, leads to the reduction of international trade. The empirical studies does not draw consensus on the negative effect of exchange rate volatility on imports and exports. The studies of Franke (1991) and Sercu and Vanhulle (1992) introduced models in which firms mostly enter the market sooner and quit the market later where there exist high volatility of exchange rate.

The debate begin from the study of De Grauwe (1988) who identified the positive effect of exchange rate volatility on trade flows, he argued that if the income effect dominates the substitution effect then there will be positive effect on trade flows. Further, Clark (1973) argued that risk aversion attribute of the traders leads to negative impact on exports, the availability of forward and future market can reduces this negative impact. The most robust evidence of positive impact of exchange rate volatility on trade flows was found by (Asseery and Peel, 1991) they criticized many past research papers for not taking into consideration the nonstationary property of the variables in estimation. They used error correction model

to draw the results, among the five countries took into analysis of which four countries exchange rate volatility have significant positive impact on international trade flows. There are many other past studies that suggest significant positive impact of exchange rate volatility on trade flows. A study of Cushman (1988) examined US bilateral trade flows with Japan where he reports what termed, Puzzling positive case, exchange rate variability had a significant positive impact on coefficients. Additional positive puzzling cases may be found in the work of Cushman (1983) in his sample of 15 cases 6 of them were reported with positive coefficients and half of them were statistically significant. Bailey et al. (1987) studied the OECD countries and found no such significant negative effect of exchange rate volatility on trade flows.

Other stream of studies including De Grauwe (1988), Dellas and Zilberfarb (1993), Broll and Eckwert (1999) and suggest to take into account both effects, substitution effect and income effect, in addressing the exchange rate volatility effect on trade flows. The main argument of these studies is that when considering the substitution effect the increase in volatility reduce trade flows but the income effect increases trade flows because firms try to offset the decline in total expected utility. In case of high risk-aversion the income effect will dominate substitution effect and higher volatility in exchange rate will lead to increase in international trade flows.

The two meta studies of McKenzie (1999) and Bahmani-Oskooee and Hegerty (2007) thoroughly investigate the literature of exchange rate volatility and trade flows, examining and connecting recent developments in the literature and differentiating these studies on the bases of econometric models used, various exchange rate volatility measures, trade flows used (sectorial, bilateral or aggregate), exchange rates (nominal, real or real effective) and the critical comparison of empirical findings. The study of Bahmani-Oskooee and Hegerty (2007) conclude that there is no consensus in the literature regarding the effect of exchange rate volatility on trade inflows and outflows, more specifically in analysing the post 1973 floating exchange rate regime which is considerably high volatile than the fixed rate regime. The study further examined but does not find any consensus in the

literature on single measure of exchange rate volatility irrespective of the many developments in the econometric analysis.

A meta study of Ćorić and Pugh (2010) analysed previous studies and conclude that past 33 studies identified significant negative effect of volatility on trade, 25 studies does not support these findings while six studies found improvement in trade flows with greater exchange rate volatility.

Other research studies have conducted in the emerging and developing countries on the impact of real exchange rate volatility on imports and exports. Like a study of Arize et al. (2000) examined the volatility effect on exports of 13 developing countries from the period of 1973-1996 using cointegration analysis, they conclude that volatility have a significant negative impact both in the short and long run on export volume.

A study by Sauer and Bohara (2001) investigate REER effect on the trade flows of 91 countries using both random and fixed effect models for the period of 1966-1993. For REER measurement they used three measures. First, eight-quarter moving standard deviation of error from an AR(1) process of real effective exchange rate, second, autoregressive conditional heteroskedasticity (ARCH) model, and thirdly eight-quarter moving standard deviation of a regression of REER on a time trend and time trend squared. They found both volatility and terms of trade statistically significant and REER have negative impact on real exports for the entire sample. Grobar (1993) studied the impact of real exchange rate volatility on export of 10 less developed countries for the period of 1963-1985 using pooled ordinary least square (POLS) as well as fixed effect model found significant negative impact of volatility on exports for 5-8 SITC countries. Using panel data analysis Chiu et al. (2010) examine the association of REER and trade flows of US with trading partners (1973-2006 annual), conclude that the dollar value depreciation reduce trade with 13 partners and dollar value appreciation increase trade flows with 37 trading partners.

Hondroyiannis et al. (2008) using three measure of exchange rate volatility examine the association between aggregated export and exchange rate volatility of 12

countries using quarterly data form 1977-2003. Further they study five econometric techniques including GMM. Real exports earnings of oil exploration countries are added as additional exogenous variable for the volume of export. The results does not found any significant effect of exchange rate volatility on export volume irrespective of the six estimation techniques used. Hondroyiannis et al. (2008) suggest for future research to investigate the role of oil exporting countries and its omission leads to the specification bias.

Another study on panel data conducted by Olayungbo (2011) explore exchange rate variability effect on trade flows of 40 African countries on data from 1986-2005. The pooled least square regression analysis (POLS) is used in gravity model as well as used GMM method. The results show positive impact of ER volatility on trade flows. Byrne et al. (2008) examine exchange rate volatility impact on the bilateral US trade by taking sectoral data found that exchange rate volatility negatively impact trade flows especially report higher coefficients for the export of differentiated goods. Huchet-Bourdon and Korinek (2011) investigate the effect of exchange rate (level and volatility) on import and export of two sectors (agriculture and mining) of China and US using autoregressive distributive lag model (ARDL). The results shows minor effect of volatility on trade while greater effect of level on trade flows among both countries. The findings further show greater effect of volatility on exports than on imports for all sectors and models.

Past studies conducted in Pakistan explore the relationship between exchange rate volatility and economic growth. In this journey an empirical study conducted by Javed and Farooq (2009) uses Error correction model plus ARDL approach. The study suggests that economic growth is positively connected with exchange rate volatility, exports, and reserve money. An interesting study by Alam and Ahmed (2010) examine the effect of exchange rate volatility on total export demand in Pakistan. The findings suggest that real exchange rate in the long-run does not change the volume of exports. Further results suggest the real exchange rate volatility does not decrease aggregate import demand, i.e. aggregate import demand is inelastic to exchange rate volatility and real depreciation of exchange rate. Alam and Ahmed (2010) studies the relationship between effective exchange

rate volatility and Pakistan import demand using quarterly data covering period of 1982-2008. The results of ARDL approach shows the there is no long-run relationship between effective exchange rate volatility on import demand in Pakistan while in the short-run exchange rate volatility Granger cause the import demand.

Previous studies used aggregated import and export data to check the effect of volatility on trade flows, these studies report inconclusive mixed results. Recent studies used bilateral industry level disaggregated trade data to check the effect of exchange rate volatility on trade flows. In this strand Bahmani-Oskooee and Wang (2007) studied the trade flows between United States and China. In 1978 the US had 600 million dollars trade surplus with China while in 2002 the China has 120 billion US dollars trade surplus and China currency had depreciated fourfold in this timeframe. The study checked that whether the depreciation of Chinese Yuen have a significant effect on the trade flows between China and USA. The effect of exchange rate volatility in 88 industries were checked on trade flows by applying error correction models and cointegration techniques. The results show that in the long run the appreciation of dollar against Chinese Yuen increase the earnings of 18 USA exporting industries while the appreciation increases out payments of 40 industries. In short, the appreciation of US dollar against the Chines Yuen deteriorate the China and US trade balance.

A study by Bahmani-Oskooee et al. (2013a) of exchange rate volatility and trade flows is conducted at bilateral level industry trade flows between emerging economy of Brazil and USA. The study adopted cointegration technique on data ranging from 1971 to 2010. The study report that in the long run many industries trade flows are not affected by the volatility in exchange rate but the sensitivity of risk different for different industries. The study show that Brazilian agriculture export is negatively affected while US machinery imports are not affected by the increase volatility in exchange rate. Another study of exchange rate volatility of bilateral industry level trade flows between Egypt and European Union trade flows conducted by Bahmani-Oskooee et al. (2015) uses quarterly cointegration analysis for 59 importing and exporting industries. The results show that few industries trade flows respond to increase exchange rate risk. But in the long-run,

large number of industries negatively respond to increase exchange rate risk. The results are significant specifically for large petroleum and gas industries. Further Egyptian non-manufacturing sector are more susceptible to increase exchange rate risk.

Aftab et al. (2012) studies the effect of exchange rate volatility on sectoral level exports of Pakistan using quarterly data ranging from 2003-2010 by applying bound testing approach of Pesaran et al. (2001). The results show for all 20 exporting industries negative effect of volatility on export. The coefficient of volatility is insignificant in three sectors (i. animal or vegetable fats, oils and waxes; ii. vehicles, aircraft, vessels and associated transport equipment; and iii. Arms and ammunition, parts) but the direction of coefficient is reported negative for all these exporting industries. Thus the need for the stability of exchange rate is indicated to increase Pakistan exports.

A recent interesting study by Bahmani-Oskooee and Aftab (2017) investigate the symmetric and asymmetric effect of exchange rate volatility and trade flows of US-Malaysian bilateral trade flows. The study uses monthly (April-2001 to December-2015) industry-level disaggregated trade flows by employing Pesaran et al. (2001) linear ARDL approach and Shin et al. (2014) nonlinear ARDL approach to assess and compare the symmetric and asymmetric effect of exchange rate volatility on 63 Malaysian importing and 54 exporting industries to the US. The study report both short-run and long-run asymmetric effect of exchange rate volatility for almost 1/3rd Malaysian importing and exporting industries. The results further suggest the asymmetric effect of exchange rate volatility is industry specific and varied from industry to industry.

2.1 Hypotheses of the Study

H1: Exchange rate volatility has a significant negative effect on Pakistan aggregate trade flows.

H2: Exchange rate volatility is negatively related to Pakistan exports.

H3: Exchange rate volatility has a significant positive influence on Pakistan imports.

H4: There exist significant negative effect of exchange rate uncertainty on Pakistan aggregate trade and exports, in short-run and long-run.

H5: Exchange rate volatility has a significant positive influence on Pakistan imports in short-term and long-term.

H6: There exist significant negative effect of exchange rate volatility on exports of various industries in short-term and long-term.

H7: There exist significant positive influence of exchange rate volatility on imports of various industries in short-term and long-term.

H8: Exchange rate volatility has a significant asymmetric effect on Pakistan imports, exports, and aggregate trade in short-term and long-term.

H9: The asymmetric influence of volatility on imports and exports is industry specific, in short-term and long-term.

Chapter 3

Data Description and Methodology

The chapter provides detail regarding data, sources of data, and methodology adopted to explain the link between exchange rate and trade flows.

3.1 Sample Description

The study explores the effect of various macroeconomic factors, especially exchange rate volatility, on aggregate and disaggregated industry level trade flows of Pakistan. The data used are secondary in nature. For all the variable in this study quarterly data is used to ensure larger samples. The data for this research work is gleaned from a variety of sources. The quarterly exchange rate data is gathered from website of the Pacific Exchange rate system. The data on imports, exports, and interest rate in Pakistan is obtained from the state bank of Pakistan. The data on CPI is gathered from Pakistan Bureau of statistics. The data on foreign remittances, industrial production (IP), and Foreign direct Investment (FDI) is gathered from World Development indicator (WDI) site of World Bank. For all the variables quarterly data covering period Q3-2003 to Q2-2018 used which is the latest dataset to understand the current dynamics of the variables and its effect.

This study investigate the effect of exchange rate volatility on Pakistan aggregate trade flows, exports, imports, and industry level disaggregated import and export as dependent variables and nominal exchange rate, exchange rate volatility, foreign direct investment, interest rate, remittances, inflation, and industrial production as explanatory variables.

3.2 Econometric Models

Past studies that examine the effect of exchange rate volatility on trade flows, imports and exports used standard explanatory variables such as real income, relative prices and exchange rate volatility (Bahmani-Oskooee and Wang, 2007; Bahmani-Oskooee and Aftab, 2017). But in this study there are some other macroeconomic variables too as explanatory variable that can potentially effect Pakistan trade flows.

Firstly, this study is designed to examine the effect of exchange rate volatility on Pakistan aggregate trade flows. Therefore the study begins with the following equation:

$$LnTF_{i,t} = \theta_0 + \theta_1 LnV_t + \theta_2 LnNEX_t + \theta_3 LnFDI_t + \theta_4 LnIR_t + \theta_5 LnRT_t + \theta_6 LnINF_t + \theta_7 LnIP_t + \mu_t \tag{3.1}$$

The above specifications are that $LnTF_{i,t}$ represent aggregate trade flows of Pakistan where i is for aggregate trade flows and t time period. θ_0 is the slope intercept and log of volatility is represented by LnV_t at time t. $LnNEX_t$ denoted nominal exchange rate, $LnFDI_t$ is the log of foreign direct investment at time t. The interest rate in Pakistan is specified as $LnIR_t$. Further, the flow of remittances into Pakistan is denoted by $LnRT_t$. Log of Inflation in the country indicated by $LnINF_t$. Lastly, $LnIP_t$ stands for natural log of industrial production index and μ_t is the disturbance term.

Secondly, the study examine the effect of exchange rate volatility on Pakistan export. Thirdly, the effect of exchange rate volatility on various industries export. Other explanatory variables are added to the equation that have potential effect on Pakistan exports. Thus the given specifications are as under:

$$LnEx_{i,t} = \alpha_0 + \alpha_1 LnV_t + \alpha_2 LnNEX_t + \alpha_3 LnFDI_t + \alpha_4 LnIR_t + \alpha_5 LnRT_t + \alpha_6 LnINF_t + \alpha_7 LnIP_t + \mu_t \tag{3.2}$$

In the above equation $LnEx_{i,t}$ denotes log of Pakistan real export in US dollars where i at first show aggregate export and secondly each industry exports at time t, LnV_t denotes log of volatility measured through GARCH process. The log of nominal exchange rate (PKR/USD) represented by $LnNEX_t$, measure relative prices at time t. The term $LnFDI_t$ denotes log of foreign direct investment in Pakistan. $LnIR_t$ Stands for log of real interest rate at time t, Remittances are denoted by $LnRT_t$. The log of quarterly inflation rate in Pakistan is shown by $LnINF_t$. Natural log of industrial production indices as a measure of economic activity is denoted by $LnIP_t$.

Thirdly, this study examine the effect of exchange rate volatility on Pakistan aggregate imports. At fifth the study will check the effect of exchange rate volatility on various importing industries on Pakistan. For import demand function in this study the traditional model with some addition of other macroeconomic variables linked to imports trade flows are added, the import demand function is as follows:

$$LnIM_{i,t} = \beta_0 + \beta_1 LnV_t + \beta_2 LnNEX_t + \beta_3 LnFDI_t + \beta_4 LnIR_t + \beta_5 LnRT_t + \beta_6 LnINF_t + \beta_7 LnIP_t + \omega_t \tag{3.3}$$

In the above equation IM represents natural log of Pakistan real import in US dollars at time t, at first i show aggregate import and at second i is for various industries imports. β_0 Is the slope intercept, LnV_t denotes log of exchange rate

uncertainty, $LnFDI_t$ is the log of foreign direct investment in Pakistan. The natural log of interest rate at time t is presented by $LnIR_t$, and log of remittances are shown as $LnRT_t$. Natural log of quarterly inflation and Pakistan industrial production are denoted by $LnINF_t$ and $LnIP_t$ respectively. At last, ω_t is for the stochastic term that captures the unexplained portion.

In the next section of modelling approach, to introduce the dynamic adjustment mechanism in equations (3.1), (3.2) and (3.3) to differentiate the short-run effect of exchange rate volatility on trade flows from that of long-run effect. in the equations the there are some additional explanatory macroeconomic variables that have a potential to effect Pakistani trade flows. Here too by following the literature the focus is on Auto regressive distributed lag (ARDL) a bound testing approach of cointegration and the equations (3.1), (3.2) and (3.3) specifying as error correction model in equation (3.4), (3.5) and (3.6), which specifications in the ARDL framework is given below.

Fourthly, the symmetric effect of exchange rate volatility on aggregate trade flow, in short-term and long-term.

$$\begin{aligned}\Delta LnTF_{i,t} = \pi_1 + \Sigma\pi_2\Delta LnTF_{t-j} + \Sigma\pi_3\Delta LnV_{t-j} + \Sigma\pi_4\Delta LnNEX_{t-j} \\ +\Sigma\pi_5\Delta LnFDI_{t-j} + \Sigma\pi_6\Delta LwnIR_{t-j} + \Sigma\pi_7\Delta LnRT_{t-j} + \Sigma\pi_8\Delta LnINF_{t-j} \\ +\Sigma\pi_9\Delta LnIP_{t-j} + \rho_1 LnTF_{t-1} + \rho_2 LnV_{t-1} + \rho_3 LnNEX_{t-1} + \rho_4 LnFDI_{t-1} \\ +\rho_5 LnIR_{t-1} + \rho_6 LnRT_{t-1} + \rho_7 LnINF_{t-1} + \rho_8 LnIP_{t-1} + \varepsilon_t\end{aligned} \tag{3.4}$$

Fifthly, the linear effect of exchange rate volatility on Pakistan export and industry-level export, in short-term and long-term.

$$\begin{aligned}\Delta LnEX_{i,t} = \varphi_1 + \Sigma\varphi_2\Delta LnEx_{t-j} + \Sigma\varphi_3\Delta LnV_{t-j} + \Sigma\varphi_4\Delta LnNEX_{t-j} \\ +\Sigma\varphi_5\Delta LnFDI_{t-j} + \Sigma\varphi_6\Delta LnIR_{t-j} + \Sigma\varphi_7\Delta LnRT_{t-j} + \Sigma\varphi_8\Delta LnINF_{t-j} \\ +\Sigma\varphi_9\Delta LnIP_{t-j} + \delta_1 LnEX_{t-1} + \delta_2 LnV_{t-1} + \delta_3 LnNEX_{t-1} + \delta_4 LnFDI_{t-1} \\ +\delta_5 LnIR_{t-1} + \delta_6 LnRT_{t-1} + \delta_7 LnINF_{t-1} + \delta_8 LnIP_{t-1} + \mu_t\end{aligned} \tag{3.5}$$

The symmetric effect of exchange rate volatility on Pakistan import and industry-level imports, in short-term and long-term.

$$\begin{aligned}\Delta LnIM_{i,t} = \Gamma_1 + \Sigma\Gamma_2\Delta LnIM_{t-j} + \Sigma\Gamma_3\Delta LnV_{t-j} + \Sigma\Gamma_4\Delta LnNEX_{t-j} \\ +\Sigma\Gamma_5\Delta LnFDI_{t-j} + \Sigma\Gamma_6\Delta LnIR_{t-j} + \Sigma\Gamma_7\Delta LnRT_{t-j} + \Sigma\Gamma_8\Delta LnINF_{t-j} \\ +\Sigma\Gamma_9\Delta LnIP_{t-j} + \lambda_1 LnIM_{t-1} + \lambda_2 LnV_{t-1} + \lambda_3 LnNEX_{t-1} + \lambda_4 LnFDI_{t-1} \\ +\lambda_5 LnIR_{t-1} + \lambda_6 LnRT_{t-1} + \lambda_7 LnINF_{t-1} + \lambda_8 LnIP_{t-1} + \omega_t\end{aligned} \tag{3.6}$$

The Δ in above specifications is the first difference operator, j represent number of lags from 1 to n, π_1 φ_1 ,and Γ_1 are equations intercept terms while ε_t, μ_t, and ω_t are white noise terms without any contemporaneous correlation.

In above equations (3.4), (3.5) and (3.6) error correction models short-run effects of exchange rate volatility on trade flows are shown in the estimates of coefficients first difference variables and long-run effects of exchange rate volatility on trade flows in aggregate trade flow equation (3.4) is measured by $\rho_2 - \rho_8$ which is normalized by ρ_1. In capturing the long-run effect the normalization procedure considers the variable of difference as zero and then solve the demand equation to calculate the normalized long-term estimates. Similarly in Error-correction model equation (3.5) short-run effect is measured by the estimates of coefficient of first difference and long-run effects are measured by the estimates of $\delta_2 - \delta_8$ normalized by δ_1. In equation (3.6) too the short run effect is measured by first difference coefficient estimates and long-run effect are measured by the estimates of $\lambda_2 - \lambda_8$ normalized by λ_1.

To validate long-run effects of exchange rate volatility I must go for the co-integration analysis. Up to this point Pesaran et al. (2001) recommend F-statistic test for joint significance of lagged level variables as a sign of cointegration.

In past all studies except Bahmani-Oskooee and Aftab (2017) with different models and its specifications assumed that exchange rate volatility effect trade flows in symmetric way but in this study argue that exchange rate volatility effect

trade flows in asymmetric way. As a unit increase in volatility of exchange rate may have different effect on trade flows than a unit decrease in exchange rate volatility. To examine for the asymmetric effect of volatility by following Bahmani-Oskooee and Aftab (2017) to decompose the volatility measure into its negative and positive changes. This will do by first the ΔLnV includes negative changes, ΔLnV^{-}, and then the changes in ΔLnV includes positive changes, ΔLnV^{+}. For such measurement of asymmetric effect of volatility I have to establish two further time-series variables one capturing decreased volatility representing the partial sum of negative changes, denoted by NCH, and the second measuring increased volatility representing the partial sum of positive changes, denoted by PCH, as given below:

$$NCH_t = \Sigma \Delta LnV_j^{-} = \Sigma min(\Delta LnV, 0) \tag{3.7}$$

$$PCH_t = \Sigma \Delta LnV_j^{+} = \Sigma max(\Delta LnV, 0) \tag{3.8}$$

The third step in the modelling approach to go back to equations (3.4), (3.5), and (3.6) specifications, here is to replace the volatility variable LnV, with NCH and PCH variables, the new specifications will be:

$$\begin{aligned}\Delta LnTF_{i,t} = \upsilon_1 + \Sigma\upsilon_2 \Delta LnTF_{t-j} + \Sigma\upsilon_3 \Delta PCH_{t-j} + \Sigma\upsilon_4 \Delta NCH_{t-j} + \Sigma\upsilon_5 \Delta Ln \\ NEX_{t-j} + \Sigma\upsilon_6 \Delta LnFDI_{t-j} + \Sigma\upsilon_7 \Delta LnIR_{t-j} + \Sigma\upsilon_8 \Delta LnRT_{t-j} + \Sigma\upsilon_9 \Delta LnINF_{t-j} \\ + \Sigma\upsilon_{10} \Delta LnIP_{t-j} + \xi_1 LnTF_{t-1} + \xi_2 PCH_{t-1} + \xi_3 NCH_{t-1} + \xi_4 LnNEX_{t-1} + \xi_5 \\ LnFDI_{t-1} + \xi_6 LnIR_{t-1} + \xi_7 LnRT_{t-1} + \xi_8 LnINF_{t-1} + \xi_9 LnIP_{t-1} + \epsilon_t\end{aligned} \tag{3.9}$$

The asymmetric effect of exchange rate volatility on Pakistan export and industry-level export, in short-term and long-term.

$$\Delta LnEx_{i,t} = \sigma_1 + \Sigma\sigma_2\Delta LnEx_{t-j} + \Sigma\sigma_3\Delta PCH_{t-j} + \Sigma\sigma_4\Delta NCH_{t-j} + \Sigma\sigma_5\Delta Ln$$
$$NEX_{t-j} + \Sigma\sigma_6\Delta LnFDI_{t-j} + \Sigma\sigma_7\Delta LnIR_{t-j} + \Sigma\sigma_8\Delta LnRT_{t-j} + \Sigma\sigma_9\Delta LnINF_{t-j}$$
$$+\Sigma\sigma_{10}\Delta LnIP_{t-j} + \varpi_1 LnEx_{t-1} + \varpi_2 PCH_{t-1} + \varpi_3 NCH_{t-1} + \varpi_4 LnNEX_{t-1} + \varpi_5$$
$$LnFDI_{t-1} + \varpi_6 LnIR_{t-1} + \varpi_7 LnRT_{t-1} + \varpi_8 LnINF_{t-1} + \varpi_9 LnIP_{t-1} + \epsilon_t \tag{3.10}$$

The asymmetric effect of exchange rate volatility on Pakistan total imports and industry-level imports, in short-term and long-term.

$$\Delta LnIM_{i,t} = \phi_1 + \Sigma\phi_2\Delta LnEx_{t-j} + \Sigma\phi_3\Delta PCH_{t-j} + \Sigma\phi_4\Delta NCH_{t-j} +$$
$$\Sigma\phi_5\Delta LnNEX_{t-j} + \Sigma\phi_6\Delta LnFDI_{t-j} + \Sigma\phi_7\Delta LnIR_{t-j} + \Sigma\phi_8\Delta LnRT_{t-j} +$$
$$\Sigma\phi_9\Delta LnINF_{t-j} + \Sigma\phi_{10}\Delta LnIP_{t-j} + \Omega_1 LnEx_{t-1} + \Omega_2 PCH_{t-1} + \Omega_3 NCH_{t-1}$$
$$+\Omega_4 LnNEX_{t-1} + \Omega_5 LnFDI_{t-1} + \Omega_6 LnIR_{t-1} + \Omega_7 LnRT_{t-1} + \Omega_8 LnINF_{t-1}$$
$$+\Omega_9 LnIP_{t-1} + \epsilon_t \tag{3.11}$$

The above specifications of equations (3.8), (3.9) and (3.10) are error correction models which Shin et al. (2014) labelled as non-linear ARDL models, while that of equations (3.4), (3.5), and (3.6) are linear ARDL models of Pesaran et al. (2001). Using the concept of Partial sum in equations (3.8), (3.9) and (3.10) nonlinear models are established by constructing NCH and PCH variables from volatility in the model. The study of Shin et al. (2014) suggests that Pesaran et al. (2001) are in the same way applicable to the above equations (3.8), (3.9) and (3.10). Shin et al. (2014) further argued that when applying the F−statistic test to nonlinear model, as in equations (3.8), (3.9) and (3.10), one should treat both NCH and PCH variables as one variable and should use the same critical values of F−test as in the case of F−test that were used to establish the cointegration in ARDL linear models, thus the nonlinear models resulted in one additional variables. This is the case mostly due to the dependency of NCH and PCH variables.

3.3 Description of Variables

3.3.1 Measuring Exchange Rate Volatility

Previous studies used real or nominal exchange rate to measure volatility, like the studies of Hooper and Kohlhagen (1978); Thursby and Thursby (1987) used nominal measure of exchange rate volatility while some studies argued that there is indifference to the result whether to use nominal or real measure of exchange rate volatility (Qian and Varangis, 1994); (McKenzie and Brooks, 1997). In this study nominal exchange rate (PKR/USD) will be used to measure volatility.

For measuring volatility most of the past studies used standard deviation where the volatility of exchange rate is measure as the degree to which exchange rate fluctuates from the mean value over time (Schnabl, 2008) (Gadanecz and Mehrotra, 2013). This method of exchange rate volatility faced with two severe problems. First, it took the assumption of normal distribution. Second, this method does not express the distribution between the unpredictable component of exchange rate process therefore it does not account for the past information of exchange rate. Due to the empirical flaws of the standard deviation technique hence this study uses the Generalized autoregressive conditional heteroskedesticity (GRCH) model or also called generalized ARCH (GARCH) for the measurement of exchange rate volatility, which is developed by Bollerslev (1986), because the exchange rate best follows the GARCH process (McKenzie, 1999) and second it best capture the past values of the exchange rate as opposed by the process of ARCH. Taking log of the exchange rate to base on prior values for the mean equation, the GARCH model is therefore derived as follows:

$$LnNEX_t = \beta_0 + \beta_1 LnNEX_{t-1} + \mu_t \tag{3.12}$$

$$h_t = \gamma_0 + \lambda\mu_{t-1}^2 + \varphi h_{t-1} \tag{3.13}$$

Where $\gamma_0 > 0, \lambda \geq 0, and, \varphi \geq 0$

In the above equation (3.13), h_t is the conditional variance that captures the mean (y_0), previous volatility information, ARCH term μ_{t-1}^2 capture the past error forecast variance, and h_{t-1} is the GARCH term in the equation. Therefore, the GARCH model, shown in above equation, programme the error term to capture the variance that conditional on the behaviour of past prices in the series thus reflecting the actual volatilities.

3.3.2 Aggregate Trade

The aggregate trade is calculated by taking the sum of imports and exports in PKR.

3.3.3 Imports and Exports

Total import and exports as well as each industry quarterly imports and exports are measured in PKR.

3.3.4 Industrial Production Index (IP)

As for imports and exports both quarterly data is used to assure large sample, moreover log of industrial production indices is used in place of Gross domestic product as a measure of economic activity. The industrial production index is debased at 2003 as base year (2003=100). The base period is used to measure the percentage changes in economic activity.

3.3.5 Nominal Exchange Rate (NEX)

Nominal exchange rate Pakistani Rupee (PKR) divided by USD is used as a measure of exchange rate.

3.3.6 Foreign Direct Investment (FDI)

Foreign direct investment (FDI) is taken as the percentage of GDP that measure foreign direct inflows to the country.

3.3.7 Inflation (INF)

Inflation is the average change in the general price level in a particular period and calculated by taking the change in consumer price index.

3.3.8 Remittances (RT)

Remittances, the amount transferred by overseas Pakistani employed in foreign countries and is measured in PKR.

Chapter 4

Data Analysis and Empirical Results

This chapter exhibits the empirical analysis of econometric models provided in the previous chapter. This chapter contains four sections. The first section discuss the descriptive statistics and correlation of all the variables in the study. The second section deal with the unit root analysis to investigate the variables order of integration. The third section is about linear autoregressive distributive lag model (ARDL) models by following the methodology of Pesaran et al. (2001) to check the symmetric effect of exchange rate volatility on Pakistan aggregate trade, import, export, 20 exporting and 20 importing industries of Pakistan. The fourth section deal with nonlinear autoregressive distributed lag (NARDL) models here by following the methodology of Shin et al. (2014) to investigate asymmetric effect of exchange rate uncertainty on trade, exports, and imports of country and industries individually and jointly as categorized by State bank of Pakistan (SBP).

4.1 Descriptive Statistics

The basic overview of the data is made through the descriptive statistics which covers mean, standard deviation, minimum, maximum, skewness, and Kurtosis. It is important to check such descriptives to ensure that data is normal and free

from outliers. Mean value indicate the middle value and standard deviation show the dispersion from the mean value. The value of skewness show that whether the location of the data is negative or positive. The skewness value ranges from -1, negative skewness, to +1, positive skewness. The kurtosis demonstrate the shape of the data. The Kurtosis estimate equal to 3 demonstrate that data is normally distributed and the pattern of the data called mesokurtic, the value greater than >3 called leptokurtic and the pattern of data is peaked with fat tails. The Kurtosis value when less than <3 called platykurtic and less peaked with thinner tails.

4.1.1 Descriptive Statistics of Aggregate Trade

In Table 4.1, descriptive statistics that include mean, standard deviation, minimum, maximum, skewness and kurtosis of the dependent variables; aggregate trade flow, exports, imports, and explanatory variables; foreign direct investment, interest rate, remittances, industrial production, inflation, nominal exchange rate, and exchange rate volatility are reported. The aggregate trade, exports, imports, FDI, Remittances, and industrial production are in thousands US dollars while quarterly interest rate and inflation are in percentages. Lastly, nominal exchange rate is in ratio form (PKR/USD) and exchange rate volatility is in form of GARCH series.

4.1.2 Descriptive Statistics of Exporting Industries

The descriptive statistics of all 20 exporting industries of Pakistan as defined by State bank of Pakistan (SBP) are reported in Table 4.2. The measure of central tendency, mean, measure of dispersion, standard deviation, minimum, maximum, and measure of location skewness and measure of shape kurtosis of all 20 exporting industries are reported in Table 4.2. The industries are placed in chronological order as defined by the State bank of Pakistan. The Textiles, coded 11, is the largest industry with 59% export share followed by vegetables with 11% market share while in contrast Arts, Collectors, and Antiques (20) is the smallest exporting

industry with just 0.05% export share. The descriptive statistics are calculated from the actuals values that are in thousand US dollars.

4.1.3 Descriptive Statistics of Importing Industries

The descriptive statistics of 20 importing industries as determined by the State bank of Pakistan (SBP) are reported in Table 4.3. Here also descriptive statistics consist of mean, standard deviation, minimum, maximum, skewness and kurtosis. The industries are placed in chronological order by their respective numbers as assigned by State Bank of Pakistan. The largest importing sector of Pakistan is Minerals, coded 05, with 25% import share followed by Machineries industry, coded 16, with 16% market share while other industries are relatively small. It is observed that the largest sectors imports are negatively skewed and smallest sectors imports are positively skewed. The Raw hide, Skin, and Leather industry coded 08 carry highest Kurtosis value of 6.39 indicating the data is highly leptokurtic. All the values are in thousands US dollars.

TABLE 4.1: Descriptive Statistics of Aggregate Trade Flow

Variables	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**	**Skewness**	**Kurtosis**
Aggregate Trade Flow	13706880.47	3751770.15	5836915.47	21392083.13	-0.92	3.01
Export	5043877.37	1103038.32	2910460.62	7242548.37	-0.62	2.29
Import	8663003.10	2755235.16	2926454.85	15068712.61	-0.99	3.44
Foreign Direct Investment	780991.33	431930.97	224003.00	2265703.00	0.00	2.39
Remittances	2884355.00	1494866.55	906500.00	5529000.00	-0.29	1.63
Industrial Production	707577.19	1291154.37	342.39	5728388.83	-0.50	2.56
Interest Rate	10.53	2.51	5.20	14.45	-0.25	1.97
Inflation	2.09	1.54	-1.29	7.94	-0.34	4.71
Nominal Exchange Rate	84.18	19.18	57.29	119.05	-0.16	1.54
Exchange Rate Volatility	1.89	3.87	0.011	5.48	-0.24	2.93

Table 4.2: Descriptive Statistics of Exporting Industries

Export Industries (Thousands US dollars)	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**	**Skewness**	**Kurtosis**
01. Live Animals	118134.46	56509.627	38724.185	226188.78	-0.24	1.71
02. Vegetable Products	582170.46	222730.43	195875.32	1061489.2	-0.69	2.45
03. Animal, Oils and Waxes	24462.224	9188.2539	9481.713	45042.103	-0.56	2.5
04. Foodstuffs; Beverages and Tobacco	163273.13	109766.94	34165.358	459019.09	-0.05	1.96
05. Mineral Products	351723.4	148532.68	36812.33	710106.93	-1.59	6.16
06. Products of Chemical	96016.605	26997.106	48921.987	180214.54	-0.29	2.55
07. Plastics and Articles	99865.444	34869.502	39160.994	167827.53	-0.68	2.33
08. Raw Hide and Skins, and Leather	255589.27	41240.888	169529.63	334963.71	-0.32	2.27
09. Wood and Articles of Wood	7283.0857	3713.7089	1798.484	13334.106	-0.42	1.76
10. Pulp of Wood or of other Fibrous	16384.614	8307.7687	2923.262	39753.254	-0.68	3.27
11. Textiles and Textile Articles	2890709.5	489868.63	1997526.1	3833593.9	-0.4	1.86
12. Footwear and Headgear	26056.713	5267.0819	16083.816	42843.843	0.03	3.17
13. Stone, Plaster, and Cement	19143.05	6462.3674	8924.851	37707.259	-0.14	2.27
14. Pearls, Precious Stones, Metals	17201.799	28083.808	2775.865	154359.05	1.26	3.44
15. Base Metals and Articles	104425.7	50786.663	24593.009	201211.34	-0.61	2.26
16. Machinery and Mechanical	52764.807	13906.056	29614.879	91468.39	-0.02	2.71
17. Vehicles, Aircraft, and Vessels	13670.902	6906.7998	4345.074	39093.516	0.19	2.57
18. Optical and Photographic	77264.568	20801.101	40793.876	118892.51	-0.34	2.19
19. Arms and Ammunition	5082.134	7522.1724	539.351	48508.049	0.8	4.05
20. Arts, Collectors, and Antiques	2375.3904	3507.8708	104.586	25400.975	-0.07	3.83

TABLE 4.3: Descriptive Statistics of Importing Industries

Importing Industries (Thousands US dollars)	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**	**Skewness**	**Kurtosis**
01. Live Animals	32874.828	20118.352	3723.886	76781.674	-0.73	2.6
02. Vegetable Products	426382.69	189163.55	97724.794	844294.18	-0.59	2.93
03. Animal, Oils and Waxes	408725.25	153042.09	154434.68	730203.1	-0.61	2.05
04. Foodstuffs; Beverages and Tobacco	133496.16	85868.227	15903.071	481173.44	-0.73	3.41
05. Mineral Products	2672708.4	1102644.8	443802.89	4691794.8	-1.24	3.95
06. Products of Chemical	1065103.3	284336.6	480344.79	1682549.4	-0.69	2.63
07. Plastics and Articles	430823.07	145147.27	160841.58	764986.97	-0.56	2.77
08. Raw Hide and Skins, and Leather	18860.192	9181.1771	7910.162	77514.473	0.81	6.39
09. Wood and Articles of Wood	24333.911	11580.68	6801.471	50727.319	-0.12	2.25
10. Pulp of Wood or of other Fibrous	131408.56	45199.821	52482.964	226647.14	-0.48	2.26
11. Textiles and Textile Articles	538343.96	264155.17	194681.16	1321692.6	0.11	2.16
12. Footwear and Headgear	8826.803	6484.7455	1386.249	24283.487	-0.17	1.79
13. Stone, Plaster, and Cement	38839.913	16270.558	20403.351	84380.129	0.73	2.65
14. Pearls, Precious Stones, Metals	1219.1473	743.66663	248.134	3211.063	-0.28	2.07
15. Base Metals and Articles	628145.93	249336.82	194890.66	1297929.6	-0.48	3.68
16. Machinery and Mechanical	1224956.2	402666.02	481605.46	2155398	-0.21	3.45
17. Vehicles, Aircraft, and Vessels	425115.85	160905.25	198047.51	990046.22	0.26	2.8
18. Optical and Photographic	112447.15	47071.159	45998.784	270968.08	0.37	2.79
19. Arms and Ammunition	8496.7694	9466.5859	1148.138	42514.819	0.4	2.33
20. Arts, Collectors, and Antiques	294957.93	173588.26	108498.5	933539.67	0.63	3.21

4.1.4 Correlation Matrix

Thereafter to check for Multicollinearity the correlation is reported in Table 4.4 among all the explanatory variables. The higher correlation is observed between Nominal exchange rate and inflation, since nominal exchange rate contains inflation element, therefore, the higher correlation is observed between the two. Second, the higher correlation between exchange rate and remittances is found, as remittances in the foreign currency are converted into domestic currency where involve exchange rate,therefore, the higher correlation is observed. Lastly, there is high association between inflation and remittances, as a higher inflation either encourage or discourage a country flow of remittances, thus,resulting in higher correlation. As this study is dealing with long-term cointegration thus the problem of higher correlation among the variables is always there.

TABLE 4.4: Correlation Matrix

Variables	**Nominal Volatility Exchange Rate**		**Foreign Direct Investment**	**Interest Rate**	**Remittances**	**Inflation**	**Industrial Production**
Nominal Exchange Rate	1						
Volatility	0.138	1					
Foreign Direct Investment	-0.281	0.344	1				
Interest Rate	0.1	0.192	0.104	1			
Remittances	0.959	0.087	-0.227	-0.035	1		
Inflation	0.985	0.119	-0.227	0.039	0.986	1	
Industrial Production	0.645	0.049	0.042	-0.403	0.679	0.677	1

4.2 Unit Root Analysis

In time series data stationarity may not be there, so, there is need to check for the unit root. Many previous studies report that unit root testing is important prior to the application of ARDL. To determine order of integration of all the endogenous and exogenous variables in the study, the widely used techniques Augmented Dicky fuller (ADF) and Phillip-Peron (PP) tests are applied at level and first difference with the assumption of constant and trend. Table 4.5 express aggregate trade flows

results of both ADF and PP with their order of integration, Table 4.6 show the results of importing and Table 4.7 exporting industries unit roots. Results indicate that all the variables are either stationary at level I (0) or at first difference I (1) but no one is integrated at I (2) or more. Thus, ARDL approach to cointegration can be safely applied. It is worth mentioning that all the variables are robust at both assumptions of constant trend and no trend. These integration tests are important to eliminate the potential spurious regression as reported by Ouattara (2004) that bound test assumptions are based on the level and first differenced. In case of I (2) variable the calculated F-statistics value becomes invalid.

4.2.1 Unit Root Analysis of Aggregate Trade

Table 4.5 represent the unit root tests of Augmented Dicky Fuller (ADF) and Philip Peron (PP) applied at level and first difference with assumption of constant and trend on trade flow, exports, imports, nominal exchange rate, interest rate, inflation, industrial production, remittances, foreign direct investment, and exchange rate volatility. Looking at the Table 4.5 all the variables are integrated either at level I (0) or I (1) but no one at I (2) which can affect the unbiased estimates of ARDL. All the variables in natural log form. The critical values of level and first difference for both ADF and PP tests has provided at 1%, 5%, and 10% respectively.

TABLE 4.5: Unit Root Analysis of Aggregate Trade Flow

Variables	ADF-Level	ADF-1st Diff	PP-Level	PP-1st Diff	Level of Integration
Ln Aggregate Trade Flow	-2	-15.102	-2.121	-24.084	I(0)
Ln Export	-1.812	-3.75	-2.646	-26.183	I(1)
Ln Imports	-2.388	-18.912	-2.235	-21.896	I(0)
Ln Nominal exchange rate	-2.103	-10.586	-2.087	-10.534	I(1)
Ln Interest Rate	-2.662	-6.648	-2.616	-8.987	I(0)
Ln Inflation	-2.702	-5.197	-2.163	-11.13	I(1)
Ln PK Industrial production	-1.646	-4.117	-2.137	-5.858	I(0)
Ln Remittances	-1.115	-16.563	-1.322	-52.571	I(0)
Ln Foreign direct investment	-2.7	-10.898	-8.125	-44.67	I(0)
Ln Exchange rate volatility	-13.44	-10.53	-13.45	-91.7	I(0)
1%Critic. Value	-3.467	-3.469	-3.466	-3.466	
5%Critic. Value	-2.877	-2.878	-2.877	-2.877	
10%Critic. Value	-2.575	-2.575	-2.575	-2.575	

4.2.2 Unit Root Analysis of Exporting Industries

In Table 4.6 results of the unit root test for major industrial exports of Pakistan are reported. The ADF and PP test at both level and first difference variables has applied and shown in the table. All the variables are either integrated at level I (0) or I (1) but there is no such case where the order of integration is I (2). So, there is no harm to apply ARDL and NARDL models. The critical values at 1%, 5%, and 10% significance level are provided at the end of the Table.

TABLE 4.6: Unit Root Analysis of Export Industries

Export Industries	**ADF-Level**	**ADF-1st Diff**	**PP-Level**	**PP-1st Diff**	**Level of Integration**
01. Live Animals	1.539	-3.478	2.681	-24.25	I(1)
02. Vegetable Products	-2.709	4.82	-2.741	-14.627	I(1)
03. Animal, Oils and Waxes	-2.192	-9.075	-5.445	-31.402	I(0)
04. Foodstuffs; Beverages and Tobacco	-2.762	-15.84	-2.554	-18.506	I(0)
05. Mineral Products	-4.801	-14.237	-4.3	-24.71	I(0)
06. Products of Chemical	-3.051	-14.301	-4.345	-24.269	I(0)
07. Plastics and Articles	-2.638	-14.36	-3.552	-25.64	I(0)
08. Raw Hide and Skins, and Leather	-2.6397	-8.5124	-4.9531	-28.077	I(0)
09. Wood and Articles of Wood	-1.819	-11.822	-3.803	-43.544	I(0)
10. Pulp of Wood or of other Fibrous	-3.213	-15.2	-4.037	-25.8	I(0)
11. Textiles and Textile Articles	-1.69	-22.222	-3.113	-38.113	I(0)
12. Footwear and Headgear	-8.405	-11.666	-8.342	-34.051	I(0)
13. Stone, Plaster, and Cement	-1.979	-15.872	-3.835	-38.5	I(0)
14. Pearls, Precious Stones, Metals	-3.2	-14.016	-5.445	-26.531	I(0)
15. Base Metals and Articles	-2.29	-14.703	-3.036	-23.98	I(0)
16. Machinery and Mechanical	-5.203	-22.38	-8.954	-50.895	I(0)
17. Vehicles, Aircraft, and Vessels	-2.214	-9.791	-9.35	-53.48	I(0)
18. Optical and Photographic	-3.195	-10.571	-9.508	-126.97	I(0)
19. Arms and Ammunition	-3.581	-14.195	-11.76	-33.367	I(0)
20. Arts, Collectors, and Antiques	-4.099	-12.62	-10.767	-39.554	I(0)
1%Critic. Value	-3.467	-3.469	-3.466	-3.466	
5%Critic. Value	-2.877	-2.878	-2.877	-2.877	
10%Critic. Value	-2.575	-2.575	-2.575	-2.575	

4.2.3 Unit Root Analysis of Importing Industries

Again both renowned unit root tests, ADF and PP has been applied on all importing industries and results are reported in Table 4.7. Industries imports at both level and first difference either integrated at I (0) or I (1) but no such as I (2), which is the limitation of ARDL that does not account for the case of I (2).

TABLE 4.7: Unit Root Analysis of Import Industries

Import Industries	**ADF-Level**	**ADF-1st Diff**	**PP-Level**	**PP-1st Diff**	**Level of Integration**
01. Live Animals	-1.914	-11.65	-3.719	-33.93	I(0)
02. Vegetable Products	-1.828	-11.16	-4.67	-37.35	I(0)
03. Animal, Oils and Waxes	-2.02	-14.08	-3.341	-29.44	I(0)
04. Foodstuffs; Beverages and Tobacco	-4.29	-16.84	-4.04	-17.79	I(0)
05. Mineral Products	-2.99	-19.93	-2.76	-24.53	I(0)
06. Products of Chemical	-2.31	-14.94	-3.43	-39.94	I(0)
07. Plastics and Articles	-2.44	-50.82	-2.9	-10.01	I(1)
08. Raw Hide and Skins, and Leather	-3.85	-11.83	-7.41	-41.87	I(0)
09. Wood and Articles of Wood	-0.96	-5.71	-3.02	-40.57	I(1)
10. Pulp of Wood or of other Fibrous	-2.49	-21.99	-2.59	-33.04	I(0)
11. Textiles and Textile Articles	-2.94	-9.79	-2.46	-20.25	I(1)
12. Footwear and Headgear	-0.89	-12.01	-3.45	-34.67	I(0)
13. Stone, Plaster, and Cement	-1.24	-9.8	-2.55	-41.97	I(1)
14. Pearls, Precious Stones, Metals	-7.09	-10.88	-12.09	-72.79	I(0)
15. Base Metals and Articles	-2.29	-19.84	-2.44	-22.65	I(1)
16. Machinery and Mechanical	-2.27	-17.39	-3.46	-33.15	I(0)
17. Vehicles, Aircraft, and Vessels	-2.62	-14.8	-3.98	-37.93	I(1)
18. Optical and Photographic	-2.76	-10.79	-6.54	-63.14	I(0)
19. Arms and Ammunition	-5.85	-9.47	-9.6	-44.45	I(0)
20. Arts, Collectors, and Antiques	-9.65	-11.33	-10.38	-88.65	I(0)
1%Critic. Value	-3.467	-3.469	-3.466	-3.466	
5%Critic. Value	-2.877	-2.878	-2.877	-2.877	
10%Critic. Value	-2.575	-2.575	-2.575	-2.575	

The main objective of this study is to investigate the symmetric and asymmetric effect of exchange rate volatility on Pakistan aggregate and industry level disaggregate trade flows. For this purpose equation (3.1) measure the effect of exchange

rate volatility on aggregate trade flows, equation (3.2) total exports, equation (3.3) total imports. Then equations (3.4), (3.5) and (3.6) in the framework of linear ARDL models measure short run and long run symmetric effect of volatility by following the methodology of Pesaran et al. (2001) on aggregate trade flow; total exports and industry-level exports; and total imports and industry-level imports respectively. Thereafter, equations (3.7), (3.8), and (3.9) in the nonlinear ARDL framework by following the Shin et al. (2014) approach is to investigate the short-term and long-term asymmetric effect of exchange rate uncertainty on trade flow, total exports and industry wise exports, and imports and industry wise imports respectively. Quarterly data covering period from Q3-2003 to Q2-2018 is used for all the variables in this study. Thereafter, by following Aftab et al. (2017) on all first difference variables maximum of four lags are applied and for optimum model selection Akaikes Information Criterion (AIC) criterion used. Thus, all the reported results belongs to each optimum model. The null hypothesis of no cointegration in this study is tested through F−statistic on maximum lags. For alternative cointegration testing the ECM_{t-1} is used by replacing the lag level variables in equations. For testing the null hypothesis of no cointegration by following the study of Pesaran et al. (2001) F−statistic is used. The F−statistic have upper and lower bound critical values, the significant estimate exceeding the upper bound will reject the null hypothesis of no cointegration while the coefficient below the lower bound will accept the null hypothesis, and coefficient between the upper and lower bounds will lead to the inconclusiveness of whether there is cointegration or not. Same like the F-statistic t-statistic have its own upper and lower bound critical values but the coefficient should be negative and significant to reject the null hypothesis of no cointegration. It is to be noted that if a statistic or a coefficient is significant at 10% (5%) level is indicated by * (**). Further all the variables are in natural log form. The critical values of F-statistic and t-statistic are given in each table notes.

4.3 Linear Relationship Between Exchange Rate and Trade Flows: An Application of ARDL Approach

The linear autoregressive distributed lag model are applied by following the Pesaran et al. (2001) general to specific methodology to draw the results. First, the symmetric effect of exchange rate volatility on trade flow is checked. Second, the symmetric effect of volatility on exports. Third, the effect of volatility on imports. Fourthly, the linear effect of exchange rate uncertainty on each export industry. Finally, the symmetric effect of exchange rate volatility on every importing industry. The model with one variable of interest exchange rate volatility also have six other macroeconomic explanatory variables.

4.3.1 Linear Relationship Between Exchange Rate and Total Trade

4.3.1.1 Basic Trade Based Model

The analysis are begin with linear models specifically aggregate trade based model. The basic models are reported in Table 4.8, associated diagnostic statistics in Table 4.9 and long-run and short-run estimates in Table 4.10 and Table 4.11 respectively. The results show significant positive coefficient of volatility but at 10% significance level. Indicating increase in trade due to increase in exchange rate uncertainty. This may be due to the expectations of buyers to earn more as the result of favourable increase in volatility. The $LnFDI_t$ have significant negative coefficient expressing that increase in Foreign direct investment decrease Pakistan aggregate trade flows. The reason of negative coefficient may be the dominance of import portion in the total trade demand equation. As economic theory states that increase in FDI in a country accelerate economic activity leads to greater exports and lesser imports. The sign of $LnINF_t$ is as expected significant and positive indicating that higher inflation in the country devalue currency leading

to higher exports and lower imports. On the same side the estimate of $LnIP_t$ is positive and significant according to the prediction indicating higher economic activity translate into higher trade flow with the world.

To validate cointegration F-statistic test is used and reported in table with upper and lower bounds critical values in table notes. The F-statistic carries significant estimate exceeding the upper bound supporting long-run cointegration in the model. At the end in the table $Adj.R^2$ have 0.973 value which mean that all the explanatory variables explain 97% variation of the total trade based model.

4.3.1.2 Diagnostic Tests For Total Trade

Diagnostic statistics are reported in Table 4.9. The diagnostics include bound test for stability of model and Wald test for the confirmation of long-run cointegration. Both tests carries significant coefficient and bound test value exceed the upper bound supporting the model stability. The Jarque-Bera test is for the normality of the data which have insignificant value supporting the data is normally distributed. The Lagrange Multiplier (LM) is for the identification of serial correlation and Ramseys RESET (RESET) for model specification. The LM test have insignificant statistic indicating autocorrelation free model. While RESET have significant value alarming the existence of model misspecification but by following the literature both Cumulative sum and Cumulative sum square tests shown by CUM and CUMQ are applied that shows stability of the estimates indicated by S.

4.3.1.3 Long-Term Relationship Between Exchange Rate and Total Trade

Now going towards long run relationships of aggregate based model which estimates are reported in Table 4.10. The Volatility carries significant positive coefficient at 10% significance level expressing that in the long run Pakistan trade flow increases as a result of higher volatility. The estimate of exchange rate is significant and negative indicating that increase in exchange rate in the long-run

reduce Pakistan trade flow. The coefficient of FDI is positive and significant expressing the increase in trade flow as a result of more foreign direct investment in the country. While the estimate of real interest rate is significantly positive which is on the contrary of economic theory states that increase in interest rate lead to the short of availability of fund to the traders and as a result the country trade flow reduce. The significant negative statistic of foreign remittances means that increase of the Pakistan remittances will expands the economic activity in the country and the aggregate trade will be reduced as explained previously the aggregate demand equation is dominated by the import proportion. The inflation have positive and significant coefficient suggesting that a higher inflation in Pakistan will increase Pakistan aggregate trade flow. At last the coefficient estimate of the industrial production is positive and significant implying that a higher economic activity in the country will boost up trade flow.

4.3.1.4 Short-Term Relationship Between Exchange Rate and Total Trade

After the long-run, the short-term cointegration estimates are reported in Table 4.11. Where trade flow lagged level estimates are reported. Aggregate trade flow carries significant positive lagged coefficients indicating short the adjustment itself in consecutive quarters. Further, at 10% significance level, volatility carries significant positive coefficient indicating short-run effect of exchange rate volatility on trade flow. The nominal exchange rate also have positive significant coefficient suggesting that in the short run an increase in exchange rate leads to increase in aggregate trade. At level FDI carries coefficient positive and significant suggesting an increase in the foreign direct investment enhance trade flow in the short run. Real interest rate possess one negative significant coefficient indicating an increase in the interest rate will decrease trade flow in the short run. The LnRT_{t-1} have positive significant coefficient suggesting that as much remittances to Pakistan increase it will enlarge Pakistan total trade flow. The consumer price index at level carries significant positive coefficient and significant negative coefficient at first

difference suggesting mix relationship. The last explanatory variable industrial production have significant positive effect on aggregated trade flow.

An alternative test for cointegration ECM_{t-1}, a negative significant coefficient as indicated in Table 4.11 supports cointegration. Pesaran et al. (2001) further suggest that for the joint significance the t-Statistic value should be greater than the upper bound critical value, where in the case of Aggregate trade flow the estimate of t-statistic is greater therefore supporting long-term cointegration.

TABLE 4.8: Coefficient Estimates of Linear Aggregate Trade Model

Particulars (Trade Share)	**Coefficient Estimates**									
	Constant	**LnV**$_t$	**LnNEX**$_t$	**LnFDI**$_t$	**LnIR**$_t$	**LnRT**$_t$	**LnINF**$_t$	**LnIP**$_t$	**F-stat.**	**Adj.R**^{2}
Ln Trade Flows (1.00)	34.15**	0.010*	0.33	-0.06**	0.536	-0.19	3.62**	0.137**	88.7**	0.973
Ln Exports (0.27)	20.89**	0.018**	0.227	-0.002	-0.37	-0.014	2.46**	0.063	65.7**	0.972
Ln Imports (0.73)	32.64**	-0.008	0.446	-0.049*	0.893*	-0.198	3.38**	0.326**	61.8**	0.97

*A. **indicate significance level at 5%, respectively. *indicate significance level at 10%, respectively. B. Respective trade share of Import and exports are given in Parentheses next to the Variables. C. V=Exchange rate volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=inflation, IP=industrial production. D. at the 5% (1%) Significance level when the number of explanatory variables are seven (K=7) the F-Statistics Lower bound critical values are 2.32 (2.96) and upper bounds critical values are 3.50 (4.26). These bound critical values are taken from Pesaran et al. (2001) Table CI Case III, Page number 36.*

TABLE 4.9: Diagnostic Statistics Associated with Table 4.8 (Linear Aggregate Trade Model)

Particulars (Trade Share)	Diagnostic Statistics						
	Bound	**Wald Test**	**Jarque-Bera**	**LM**	**RESET**	**CUM**	**CUMQ**
Ln Trade Flows (1.00)	5.48**	88.73**	1.594	1.045	7.46**	S	S
Ln Exports (0.27)	7.89**	65.68**	0.1911	0.665	9.297**	S	S
Ln Imports (0.73)	2.352	61.80**	1.6846	2.73	0.653	S	S

**indicate significance level at 5%, respectively. B. Trade share of imports and exports in total trade is shown in Parentheses next to each variable. C.Bound is the is the model stability test. Jarque-Bera is the goodness-of-fit test for the sample normality. LM is the residual serial correlation test stands for Lagrange Multiplier and With one degree of freedom is distributed as X^2. REST is the Ramseys Reset test for the model Misspecification it is also denoted by X^2 with one degree of freedom. CUM and CUMQ Shows Cumulative sum and cumulative sum of squares tests for the stability of the Model and Indicated by S for stable and U for unstable.

TABLE 4.10: Long-Run Coefficient Estimates of Linear Aggregate Trade Model

Particulars (Trade Share)	Long-Run Coefficient Estimates							
	Constant	**LnV_t**	**LnNEX$_t$**	**LnFDI$_t$**	**LnIR$_t$**	**LnR$_t$**	**LnINF$_t$**	**LnIP$_t$**
Ln Trade Flows (1.00)	20.99**	0.006*	-1.04**	-0.05**	0.167**	-0.94**	2.162**	0.084**
Ln Exports (0.27)	19.94**	0.018**	-0.019	-0.09**	0.224**	-0.81**	1.208	0.061
Ln Imports (0.73)	21.14**	-0.007	-1.155**	-0.053**	0.115**	-0.98**	2.19**	0.139**

A. **indicate significance level at 5%, respectively. *indicate significance level at 10%, respectively. B. Trade share of imports and exports in total trade is shown in Parentheses Next to each variable C. V=Exchange rate volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial Production. C. Trade share is the percentage proportionate share of each industry in the total trade over the sample period.

TABLE 4.11: Short-Run Coefficient Estimates of linear Aggregate Trade Model

Particulars (Trade Share)	Short-run Coefficient Estimates							
	$LnDV_{t-1}$	$LnDV_{t-2}$	LnV_t	LnV_{t-1}	$LnNEX_t$	$LnNEX_{t-1}$	$LnNEX_{t-2}$	$LnFDI_t$
Ln Trade Flows (1.0)	0.622**	0.356**	0.010*		0.328	1.025*		-0.06**
Ln Exports (0.27)	0.447**		0.018**		0.227	1.035*	0.708	-0.002
Ln Imports (0.73)	0.529**	0.259*	-0.008	0.012	0.446	1.473**	-1.560**	-0.049*

Particulars (Trade Share)	Short-run Coefficient Estimates							
	$LnFDI_{t-1}$	$LnIR_t$	$LnIR_{t-1}$	$LnIR_{t-2}$	$LnRT_t$	$LnRT_{t-1}$	$LnRT_{t-2}$	$LnINF_t$
Ln Trade Flows (1.0)		0.536	0.27	-0.971**	-0.19	0.307**	0.069	3.62**
Ln Exports (0.27)	0.042*	-0.372	0.665	-0.930**	-0.014	-0.114	0.155	2.46**
Ln Imports (0.73)		0.893*	0.24	-0.827	-0.198	0.288	0.14	3.38**

Particulars (Trade Share)	Short-run Coefficient Estimates					
	$LnINF_{t-1}$	$LnINF_{t-2}$	$LnIP_t$	$LnIP_{t-1}$	$LnIP_{t-2}$	ECM_{t-1}
Ln Trade Flows (1.0)	-2.37**		0.137**			-1.627** (-6.75)
Ln Exports (0.27)	-2.31**	-2.573*	0.063	0.138	-0.173**	-1.048** (-6.71)
Ln Imports (0.73)			0.326**	0.104	-0.042	-1.545** (-5.57)

*A. **indicate significance level at 5%, respectively. *indicate significance level at 10%, respectively. B. Trade share is the percentage proportionate share of each industry in the total trade over the sample period. C. V=Exchange rate volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. D. The t-ratio values are given in the parentheses next to ECM_{t-1}. The t-ratio upper bound critical values at 5% (1%) significance level when number of exogenous variables seven (k=7) are -4.57 (-5.19) and lower bounds are -2.86(-3.43). These values are taken from the Pesaran et al. (2001) Table C 02, case III, and page number 38.*

4.3.2 Linear Relationship Between Exchange Rate and Exports

4.3.2.1 Basic Export Based Model

In Tables 4.8, 4.9, 4.10, and Table 4.11 below the aggregate trade flow basic, diagnostics, long-run, and short run statistics are reported respectively of the export based model. Looking at Table 4.8 Volatility carries significant positive coefficient indicating that a higher volatility leads to increase in Pakistan exports. As this volatility is mostly due to the result of Pakistani rupee depreciation which make domestic products cheaper to foreign buyers and the demand for domestic products rise as a result total exports increased. A rise in consumer price index trigger to the availability of domestic goods at cheaper rates resulting into increase of country exports, as indicated by the significant positive coefficient of Inflation. The estimate of F-statistic is greater than the Pesaran et al. (2001) upper bound limit as reported in table notes and significant validating cointegration. Next the adjusted coefficient of determination value is 0.972 means 97% of the changes in export is explained by the model.

4.3.2.2 Diagnostic Tests for Total Exports

The above result of cointegration is supported by some diagnostic statistics reported in Table 4.9. In the diagnostics bound test of model stability carries significant value exceeding upper bound at 5% significance level implying model stability. The cointegration is further confirmed by the significant value of Wald test. Additionally, the data is normally distributed as shown by the insignificant value of Jarque-Bera. The Lagrange Multiplier (LM) have insignificant value indicating autocorrelation free data. But that of Ramseys RESET (RESET) test have significant coefficient suggesting the availability of model misspecification. But both CUM and CUMSQ tests express model stability shown by S.

4.3.2.3 Long-Term Relationship Between Exchange Rate and Exports

Now extending the discussion to Long-term cointegration which results are reported in Table 4.10. The variable of interest, exchange rate variability carries significant positive coefficient suggesting that a higher volatility in exchange rate, as discussed earlier mostly as a result of rupee depreciation, increase Pakistan exports. This positive effect of exchange rate volatility may be due to the expectation of buyers and adverse fluctuation in the exchange rate which affect export favourably. The coefficient attached to foreign direct investment is significant and negative indicating that a rise in FDI discourage country exports. The positive significant coefficient of interest rate suggesting that a rise in interest rate increase Pakistan exports. Furthermore, the significant negative estimate of remittances show a decline in exports due to increase in Pakistan remittances. This significant negative coefficient may be due to a rise in remittances increase household consumption as a result households substitute domestic goods with expensive imported goods.

4.3.2.4 Short-Term Relationship Between Exchange Rate and Exports

The short run coefficients of export based model are presented in Table 4.11. The export variable carries significant positive lagged level coefficient indicating the adjustment itself in the consecutive quarters. The significant coefficient of volatility representing a higher volatility resulting in a higher exporting balance. The nominal exchange rate is as expected positive and significant coefficient that implying that as rupee depreciate Pakistan exports more to the world. At 10% significance level the coefficient estimate of FDI is positive and significant implying that a rise in foreign direct investment will lead to an increase in Pakistan exports. Further as interest rate increases leads to the reduction of export in the short run due to the short in availability of funds to traders. The consumer price index carries significant positive and then negative coefficient indicating the indifference of a rise and fall in exports as a result of increase in inflation. Contrary to the expected, industrial production represent one significant negative lagged level

coefficient indicating that export reduce with the rise of economic activity in the country.

The error correction specification are reported at the end of Table 4.11 and the associated t-test value next to the ECM_{t-1}. The coefficient of ECM_{t-1} is negatively significant and t-test estimates exceeds the upper limit of -4.57 which too support the existence of cointegration in the export based model.

4.3.3 Linear Relationship Between Exchange Rate and Imports

4.3.3.1 Basic Import Based Model

The basic import based model results is reported in Table 4.8. The volatility have negative coefficient but insignificant. The foreign direct investment is attached with negative significant coefficient at 10% significance level. The negative significant coefficient demonstrate that with a rise in exchange rate encourage economic activity in the country so the availability of products at country will discourage the demand for imported goods. The positive coefficient attached to interest rate is insignificant at 95% confidence level but when extending the confidence level to 90% the coefficient becomes significant. The rise in interest rate encourage the demand for imported goods because the upward movement in interest rate discourage domestic economic activity so the demand for imported goods increased. The growth in inflation carries significant positive coefficient implying that a rise in inflation will increase the demand for imported goods. Furthermore, $LnIP_t$ contrary to the expectation carries positive significant coefficient demonstrating that increase in economic activity lead to extension of import based model.

To validate the cointegration in import based model by following of Pesaran et al. (2001) the value of F-statistic is significantly higher than the upper bound critical value of 3.50 rejecting the null hypothesis of no cointegration. At lastly, the coefficient attached to Adj.R^2 suggesting that 97% of the variation in import demand is explained by the model.

4.3.3.2 Diagnostic Tests for Import Based Model

The associated diagnostic statistics are presented in Table 4.9. The significant estimate of bound test show optimum model stability. The existence of cointegration is confirmed by the significant Wald test. Jarque-Bera carries insignificant estimate demonstrating that data is normally distributed. Further the data have autocorrelation indicated by the significant estimate of LM test. The insignificant value of RESET suggesting that the model is well specified and further the stability of the model is supported by the Cumulative sum and Cumulative sum square tests indicated by S.

4.3.3.3 Long-Term Relationship Between Exchange Rate and Imports

Now extending the discussion to Long-term import based model in Table 4.10. Where the volatility of coefficient carries negatively effecting import based model but statistically insignificant. The nominal exchange rate have negative significant coefficient demonstrating that rupee appreciation discourage import demand because a fall in exchange rate increase the purchasing power of the consumers in return the demand for imported goods increased in the long run. A rise in foreign direct investment in Pakistan boost economic activity and discourage long-term import demand significantly. Furthermore, the statistically significant positive coefficient attached to real interest rate implying that a rise in interest rate reduce the availability of funds in the country which as a result reduce economic activity leads to the increase in demand for imported products. On the contrary a rise in remittances reduce the long-term import flows to country. A positive significant coefficient of LnINF implying that a rise in inflation result in a higher import demand. The proxy for economic activity industrial production carries statistically significant positive coefficient demonstrating that in the long run a higher economic activity in the country will increase the import demand.

4.3.3.4 Short-Term Relationship Between Exchange Rate and Imports

In Table 4.11 the short-term coefficients for imports are reported where the lagged level positive significant coefficients of the dependent variable indicating that in the upcoming quarters the part of import demand is adjusted itself. The exchange rate is attached with significant coefficient in the first quarter and negative in the second quarter suggesting first rupee depreciation increase import demand and then subsequently decrease the demand for imported goods. The negative coefficient attached to FDI significant at 90% confidence interval suggesting that a rise foreign direct investment in the short-term will reduce the demand for imported stuff. The single positive significant (10%) coefficient of real interest rate demonstrating once the higher interest rate discourage economic activity in the country the demand for domestic products will be substituted with the demand for imported goods. The LnINF_t positive significant estimate implying that an increase in inflation will increase in the short run the consumption of imported goods. Thereafter, contrary to the expected in the short run a higher economic activity leads to a higher demand for imports.

After replacing the specification in import based model with error correction framework to alternatively test for the availability of conintegration. The negative significant coefficient attached to ECM$t-1$ in addition, suggested by Pesaran et al. (2001), the t-value exceeds the upper limit supporting the existence of cointegration in the import demand model.

TABLE 4.12: Coefficient Estimates of Linear Industry-Level Export Model

Industry (Trade Share)	**Coefficient Estimates**									
	Constant	**LnV**$_t$	**LnNEX**	**LnFDI**$_t$	**LnIR**$_t$	**LnRT**$_t$	**LnINF**$_t$	**LnIP**$_t$	**F-stat.**	**Adj. R**^{2}
11-Textiles (0.59)	8.62**	0.013**	0.473*	-0.025	0.229	0.181**	0.907*	0.215**	56.06**	0.966
02-Vegetable (0.11)	-10.28	-0.001	2.698*	0.054	1.176	0.406	-0.7	0.105	20.19**	0.926
05-Minerals (0.05)	12.99**	0.031*	-0.024	0.081	0.576	-0.396	7.77**	0.294	27.43**	0.939
04-Foodstuff (0.052)	20.29	-0.022	-4.137	0.065	0.283	-0.288	15.6**	0.101	29.47**	0.952
08-Skins and Leather (0.04708)	24.6**	0.044**	0.016	-0.047*	-0.774	0.085	4.41**	0.263**	20.37**	0.908
01-Live Animals (0.034)	13.94**	0.018	-0.26	0.029	-0.015	0.085	1.604	0.056	93.47**	0.976
06-Chemicals (0.027)	9.45*	-0.001	-1.842*	0.047	2.768**	0.078	-1.538	0.252	13.70**	0.893
15-Metals (0.023)	8.94	-0.011	1.087	-0.27**	0.642**	-0.001	1.15	0.039	30.03**	0.924
07-Plastics (0.020)	3.18	-0.05**	2.055	-0.104	3.627**	0.655*	-1.436	0.245	15.15**	0.889
18-Photographic (0.01831)	13.85**	0.025**	-0.848*	0.057**	0.595*	0.556**	1.219	-0.171*	79.52**	0.979
16-Machineries (0.00665)	33.82**	0.043**	1.909	-0.114	0.118	-0.288	-0.496	-0.713**	5.09**	0.641
12-Footwears & Umbrellas (0.0043)	35.72**	0.079**	-1.654	-0.120*	2.605**	0.028	3.66**	-0.018	6.88**	0.803
10-Pulps of Wood (0.0038)	31.2**	-0.11**	-1.358	-0.39**	2.66	1.28**	-16.93**	0.172	11.31**	0.857
17-Vehicles (0.0031)	62.3**	0.016	-7.00**	-0.017	-5.47*	-0.554	23.8**	-0.218	10.9**	0.886
03-Oils and Waxes (0.00213)	66.5**	0.029	2.752	-0.106	-1.95	0.1498	5.74**	-0.824**	12.7**	0.865

Table 4.12 (Continued)

Industry (Trade Share)	Coefficient Estimates									
	Constant	**LnV**$_t$	**LnNEX**$_t$	**LnFDI**$_t$	**LnIR**$_t$	**LnRT**$_t$	**LnINF**$_t$	**LnIP**$_t$	**F-stat.**	**Adj. R**^{2}
13-Stones and Cement (0.00183)	3.38	0.030**	-0.861	0.037	1.038**	0.232	4.47**	-0.054	28.79**	0.827
09-Woods (0.0018)	-4.74	0.031	1.527	0.074	-3.035*	-0.28	4.19**	0.367	22.76**	0.92
19-Arms and Ammunition (0.00083)	-12.66	-0.071	-1.093	-0.455	-0.073	0.561	-0.378	0.656	5.02**	0.701
14- Precious Stones (0.00065)	9.61	-0.18**	-6.45	-0.376	6.34*	0.945	8.55*	0.779	8.76**	0.792
20-Arts and Antiques (0.000477)	1.525	-0.28**	-2.987	-0.082	1.125	-0.275	28.7**	-0.765**	6.75**	0.764

*A. **indicate significance level at 5%, respectively. *indicate significance level at 10%, respectively. B. V=Exchange rate volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, Inflation=Inflation, IP=industrial production. C. at the 5% (1%) significance level when the number of explanatory variables are seven (K=7) the F-Statistics Lower bound critical values are 2.32 (2.96) and upper bounds critical values are 3.50 (4.26). These bound critical values are taken from Pesaran et al. (2001) Table CI Case III, Page number 36. D. 11—Textiles and Textile Articles (0.5905), 02—Vegetable Products (0.1102), 05—Mineral Products (0.0534), 04—Prepared Foodstuffs; Beverages, Spirits, Vinegar and Tobacco (0.0516), 08—Raw Hide and Skins, Leather, Fur skins and Articles thereof (0.04708), 01—Live Animals and Animals Products (0.03375), 06—Products of Chemical or Allied Industries (0.02727), 15—Base Metals and Articles or Base Metal (0.02226), 07—Plastics and Articles thereof; Rubber and Articles thereof (0.01985), 18—Optical, Photographic, Cinematographer, Measuring, Precision Apparatus (0.01831), 16—Machinery and Mechanical Appliances (0.00665), 12—Footwear, Headgear, Umbrellas, Walking Sticks etc. (0.00430), 10—Pulp of Wood or of other Fibrous Cellulosic Material (0.00379), 17—Vehicles, Aircraft, Vessels and Associated Transport Equipment (0.00306), 03—Animal or Vegetable Fats, Oils and Waxes (0.00213), 13—Articles of Stone, Plaster, Cement, Asbestos, Mica or similar Materials (0.00183), 09—Wood and Articles of Wood (0.00180), 19—Arms and Ammunition, Parts and Accessories thereof (0.00083), 14—Natural or Cultured Pearls, Precious or Semi-Precious Stones, Metals (0.00065), 20—Works of Arts, Collectors, Pieces, Antiques and Special Transactions NES (0.000477)*

4.3.4 Linear Relationship Between Exchange Rate and Industry-Level Export

4.3.4.1 Basic Industry-Level Export Based Model

Now the concentration is on the linear industry level export based model. The estimates of basic ARDL model are reported in Table 4.12 and associated diagnostic statistics in Table 4.13 followed by long-run estimates in table Table 4.14 and short-run coefficients in Table 4.15. Looking at the basic results of linear export based model the exchange rate volatility carries 10 out of 20 significant coefficients coded 11, 08, 07, 18, 16, 12, 10, 13, 14, and 20. While in industries coded 11, 08, 18, 16, 12, and 13 carries significant positive coefficients and remaining four exporting industries coded 07, 10, 14, and 20 have negative significant coefficients. Including in the positive effect are two of the industries 11 (Textiles and Textile Articles 59% market share) and 08 (Raw Hide and Skins, Leather, Fur skins and Articles thereof with market share of 5%) whose exports are favourably affected by the volatility in exchange rate. The rupee mostly facing the downward movement as a result volatility creating therefore the exporting industries are benefiting from such favourable fluctuations. On the other hand in the second group of negative effect are industries 07 (Plastics and Articles thereof; Rubber and Articles thereof) market share of almost 2% and remaining less than 1% market share in the total export of Pakistan. When extending the discussion to 10% significance level the industry 05 (Mineral Products) have market share of more than 5% and carries significant positive coefficient means industry increase exports as a result of more uncertainty in exchange rate.

The nominal exchange rate of industry17 (Vehicles, Aircraft, Vessels and Associated Transport Equipment 0.00306) carries significant negative coefficient demonstrating that industry 17 exports less when rupee appreciates. The four industries coded 11, 02, 06, and 18 have significant coefficient at 90% confidence level. From the four industries two coded 11 and 02 show positive and the rest of two coded 06 and 18 negative coefficients. The first group have industries of largest market

share 11 (Textiles and Textile Articles 59% market share) and 02 (Vegetable Products 11% market share) implying that both the industries export more as rupee depreciate.

The industries coded 15, 18, and 10 have significant FDI coefficients in which industry coded 18 positively while industries 15 (Base Metals and Articles or Base Metal, 2% market share) and 10 negative estimates. Extending the confidence level to 90% the industries coded 08 and 12 becomes significant both of the industries reduce export with a rise of FDI in Pakistan.

The next endogenous variable real interest rate attached with five significant positive coefficients in industries coded 06, 15, 07, 12, and 13. The positive coefficients of IR demonstrate that a rise in interest rate increase the exports of these industries. At 10% significance level sectors coded 18, 17, 09, and 14 also have significant estimates where 17 and 09 as expected carries negative coefficient implying that the increase interest rate hurt economic activity leads to fall of exports.

The variable Ln RT as expected have significant positive coefficients in the following industries coded 11, 18, and 10. As remittances increase the economic activity in the country improves as a result these industries export more.

The Inflation coefficient of ten industries coded 05, 04, 08, 12, 10, 17, 03, 13, 09, and 20 are significant. Where industries coded 05, 04, 08, 12, 17, 13, 09, and 20 carries positive and remaining two industries 10 and 03 have negative coefficients. The first group have three of the largest exporting industries 05 (Mineral Products, 5.3% market share), 04 (Prepared Foodstuffs; Beverages, Spirits, Vinegar and Tobacco have 5.2% market share) and 08 (Raw Hide and Skins, Leather, Fur skins and Articles thereof, market share 4.7%). Extending the limit of confidence level from 95% to 90% the largest industry 11 (Textiles and Textile Articles, 59% market share) as well as industry coded 14 becomes significant with positive coefficients. A higher inflation in the country depreciate currency leading to the availability of domestic products in international markets at cheaper rates thus in return the country exports increased.

Thereafter, with an increase in economic activity in the country industries coded 11 and 08 have significant positive and industries coded 16, 03, and 20 significant

negative coefficients. As much economic activity increases in the country industry 11 (textiles and textile articles, 59% market share) and industry 08 (Raw Hide and Skins, Leather, Fur skins and Articles thereof, 4.7% market share) boost the volume of exports.

All the industries have significant F-statistic coefficients that exceeds the upper limit critical value 3.50 of Pesaran et al. (2001) supporting the cointegration in all the industries of export based model. The Adj.R^2 estimates demonstrate that major portion of the export demand equation is explained by the explanatory variables in all most all the industries especially industries with greater market share.

TABLE 4.13: Diagnostic Statistics Associated with Table 4.12 (Linear Export Based Model)

Industry (Trade Share)	Diagnostic Statistics						
	Bound	**Wald Test**	**Jarque-Bera**	**LM**	**RESET**	**CUM**	**CUMQ**
11-Textiles (0.59)	6.417**	56.05**	2.33	1.108	7.54**	S	S
02-Vegetable (0.11)	7.665**	93.47**	1.18	2.88	2.639	S	S
05-Minerals (0.05)	5.915**	27.43**	1.679	2.864	2.399	S	S
04-Foodstuff (0.052)	7.623**	29.47**	1.924	2.51	0.0082	S	U
08-Skins and Leather (0.04708)	7.294**	20.37**	0.043	1.776	2.293	S	S
01-Live Animals (0.034)	7.66**	93.47**	1.18	1.76	2.639	S	S
06-Chemicals (0.027)	5.23**	13.70**	1.214	2.7	0.0299	S	U
15-Metals (0.023)	4.145**	30.03**	1.0749	0.923	1.646	S	S
07-Plastics (0.020)	5.05**	16640.4**	0.768	1.86	7.59**	S	S
18-Optical and Photographic (0.01831)	12.41**	79.59**	0.003	2.066	0.516	S	U
16-Machineries (0.00665)	5.47**	12423.6**	1.809	0.796	0.693	S	S
12-Footwears & Umbrellas (0.0043)	7.864**	6.886**	0.553	1.509	0.0404	S	S
10-Pulps of Wood (0.0038)	6.53**	11.31**	0.666	4.45**	0.879	S	S
17-Vehicles (0.0031)	6.18**	5527.9**	0.5092	4.05	5.65**	S	U
03-Oils and Waxes (0.00213)	3.91**	12.77**	2.7187	0.93	1.66	S	S
13-Stones and Cement (0.00183)	3.61**	28.79**	1.2411	0.707	0.0058	S	S
09-Woods (0.0018)	3.43	22.76**	1.361	2.88**	7.68**	S	S
19-Arms and Ammunition (0.00083)	6.06**	5.02**	0.4942	4.57**	0.402	S	S
14-Precious Stones (0.00065)	3.26	8.76**	1.412	1.565	18.4**	S	S
20-Arts and Antiques (0.000477)	5.32**	6.75**	2.73	2.74	1.175	S	U

*A. **indicate significance level at 5%. *indicate significance level at 10%. B. The complete description of industries are given in the table notes of Table 4.12. C. Bound is the model stability test. Jarque-Bera is for data normality. LM is the residual serial correlation test stands for Lagrange Multiplier and with one degree of freedom is distributed as X^2. REST is the Ramseys Reset test for the model misspecification it is also denoted by X^2 with one degree of freedom. CU stands for Cumulative sum and CUQ for square of cumulative sum both test are for model stability. Where S show model stability and U tells that model is Unstable at 5% significance level.*

4.3.4.2 Diagnostics Tests for Industry-Level Export Model

The related diagnostic statistics of export based model are reported in Table 4.13. The significant values of bound test in all the exporting industries except industries coded 09 and 14 demonstrate that all the models are statistically stable. The long run cointegration is confirmed by the highly significant estimate of Wald test. The Jarque-Bera insignificant coefficient indicate that the data of all exporting industries is normally distributed. All exporting sectors are almost free from serial correlation except three relative small sectors where Lagrange Multiplier (LM) carries significant coefficients. In five industries coded 11, 07, 17, 09, and 14 the coefficient of Ramseys RESET test are significant indicating model misspecification. The cumulative sum (CUM) test show the stability of all the models indicated by S. The cumulative sum square (CUMQ) test implying that all the model are stable expressed by S except that of five industries coded 04, 06, 18, 17, and 20 indicated by U, where the model is unstable the dummy variable is placed to bring stability in the model.

TABLE 4.14: Long-Run Coefficient Estimates of Linear Export Model

Industry (Trade Share)	**Long-Run Coefficient Estimates**							
	Constant	**LnV**$_t$	**LnNEX**$_t$	**LnFDI**$_t$	**LnIR**$_t$	**LnRT**$_t$	**LnINF**$_t$	**LnIP**$_t$
11-Textiles (0.59)	13.45**	-0.012	-0.327	-0.039*	0.167**	-0.202	0.967	0.004
02-Vegetable (0.11)	-2.731	0.018**	0.999*	0.043	0.797**	1.17**	-1.358	-0.014
05-Minerals (0.05)	6.69**	0.082**	-0.995**	0.181**	1.475**	-0.204	1.171*	0.009
04-Foodstuff (0.052)	29.53**	-0.27	-20.08*	0.228	-1.101	-6.05**	28.17**	-0.805
08-Skins and Leather (0.04708)	25.04**	0.05**	1.21*	-0.40**	0.28**	-0.64**	-1.19	0.27**
01-Live Animals (0.034)	21.34**	-0.023	-3.707**	0.044	-0.023	-3.03**	8.70**	-0.125
06-Chemicals (0.027)	5.099*	-0.005	-2.505**	0.063	0.398**	0.00	2.86**	-0.14**
15-Metals (0.023)	12.14*	-0.084**	2.685	-0.165	0.871**	-1.505*	1.56	0.053
07-Plastics (0.020)	1.919	-0.030**	0.002	-0.354**	0.419**	1.24**	-0.956	0.041
18-Optical and Photographic (0.01831)	5.59**	0.015**	0.078	0.019	0.023	0.442**	-0.351	0.046**
16-Machineries (0.00665)	17.67**	0.023**	0.065	-0.202**	0.737**	-0.429	-0.025	0.031
12-Footwears & Umbrellas (0.0043)	26.13**	0.093**	2.372	-0.325**	0.327**	-0.788	-2.44	0.303**
10-Pulps of Wood (0.0038)	21.39**	-0.028	-0.931	-0.191	0.338	-1.88**	3.34**	0.171*
17-Vehicles (0.0031)	45.29**	0.054	-7.596	-0.12	0.509	-5.26*	12.77*	-0.132
03-Oils and Waxes (0.00213)	36.75**	-0.007	-2.080**	-0.611**	0.918**	-2.13**	3.167**	0.083
13-Stones and Cement (0.00183)	3.578	0.032**	-0.912	0.039	1.099**	0.246	0.908	-0.176**
09-Woods (0.0018)	-4.51	0.058*	-3.389**	-0.014	0.186	0.459	3.99**	-0.269**
19-Arms and Ammunition (0.00083)	-17.97	-0.22	-31.61*	0.988	-3.93*	0.795	28.03*	-1.691
14-Cultured Pearls (0.00065)	10.96	-0.539**	-4.135	-0.820*	2.33**	-2.21	9.75*	-0.309
20-Arts and Antiques (0.000477)	1.96	-0.386**	-3.842	0.813	-3.48**	-6.08	19.94	-0.984*

*A. **indicate significance level at 5%. *indicate significance level at 10%. B. V=Exchange rate variability, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. C. Trade share is the percentage proportionate share of each industry in the total trade over the sample period. D. The complete particulars of all the industries are reported in Table 4.12.*

4.3.4.3 Long-Term Relationship Between Exchange Rate and Industry-Level Export

The long run coefficients of linear industry level export based model are presented in Table 4.14. The variable of interest volatility have significant coefficient in the industries coded 02, 05, 08, 15, 07, 18, 16, 12, 13, 14, and 20. From the significant coefficients seven industries coded 02, 05, 08, 18, 16, 12, and 09 attached with positive coefficients, implying that as uncertainty increased, Pakistan export more of these goods. Among these positive effect some are the largest industries like 02 (Vegetable Products, 11%), 05 (Mineral Products, 5.3%), and 08 (Raw Hide and Skins, Leather, Fur skins and Articles thereof, 4.7%) market share. On the contrary four industries negatively respond to the volatility of exchange rate coded 15, 07, 14, and 20. The nominal exchange rate have five negative significant coefficients in industries coded 05, 01, 06, 03, and 09, demonstrating that as rupee appreciates, Pakistan exports more of these products to the world. Extending the discussion to 90% confidence level further four sectors coded 02, 04, 08 and 19 carries significant coefficients, where 02 and 08 are positively and 04 and 19 negatively affect export balance.

Moreover, FDI have six significant coefficients in industries termed 05, 08, 07, 16, 12, and 03, where one sector 05 (Mineral Products 0.0534) carries positive and remaining five negative effect on Pakistan exports. At 10% significance level industries coded 11 (Textiles and Textile Articles, 0.59) and 14 show also significant negative coefficients of foreign direct investment.

A higher real interest rate result in greater exports of twelve industries coded 11,02, 05, 08, 06, 15, 07, 16, 12, 03, 13, and 14. While only the exports of the industry 20 (Works of Arts, Collectors, Pieces, Antiques and Special Transactions) decrease with an increase of real interest rate. As the flow of remittances increased Pakistan exports less of the following five industries coded 04, 08, 11, 10, and 03, as indicated by negative significant coefficients. On the other hand, industries figured 02, 07, and 18 have long-term significant positive estimates implying a rise in remittances encourage the Pakistan exports of these products. Where one is the largest industry coded 02 (Vegetable Products) with market share of

11% export more in the long run as a result of rise in flow of remittances to Pakistan. This can be argued that flow of remittances have both positive effect on some and negative effect on others because higher remittances grow economic activity in the country and on the other hand increase household consumptions. Moreover, in the long run the following industries coded 05, 01, 06, 10, 17, 03, 09, 19, and 14 export more as inflation in the country increased as indicated by the significant positive coefficients attached to INF, where industries 05, 17, 19, and 14 are significant at 90% confidence level. The only one sector coded 4 (Prepared Foodstuffs; Beverages, Spirits, Vinegar and Tobacco, 0.052 market share) export less as a result of higher inflation in the country. As for the effect of economic activity, the results express that as expected four industries coded 08, 18, 12, and 10 carries significant positive coefficients. Thus, it shows that in the long-tem a growing Pakistani economy encourage to export more of these products. While on the contrary, four industries coded 06, 13, 09, and 20 depict negative coefficients implying that a growing economic activity in the long run discourage the export of these products.

TABLE 4.15: Short-Run Coefficient Estimates of Linear Export Model

Industry (Trade Share)	**Short-Run Coefficient Estimates**									
	LnDV$_{t-1}$	**LnDV**$_{t-2}$	**LnDV**$_{t-3}$	**LnV**$_t$	**LnV**$_{t-1}$	**LnV**$_{t-2}$	**LnV**$_{t-3}$	**LnNEX**$_t$	**LnNEX**$_{t-1}$	**LnNEX**$_{t-2}$
11-Textiles (0.59)	-0.079	-0.116	-0.38**	0.013**	0	0.010*	0.005	0.473*		
02-Vegetable (0.11)	2.481**	1.448**	0.52	-0.001	-0.032	-0.025		2.698*	3.880*	-2.476
05-Minerals (0.05)	1.148**	0.881**	0.201	0.031*	-0.014	-0.04**	-0.04**	-0.024		
04-Foodstuff (0.052)	-0.404	-0.67**	-0.358*	-0.022	0.022	0.016	0.104**	-4.137	3.289	7.635**
08-Leather (0.04708)	0.259**			0.044**	-0.013*			0.016	-0.791	0.83
01-Live Animals (0.034)	-0.56**	-0.55**	-0.58**	0.018	0.003	0.003	0.016	-0.26	2.054**	
06-Chemicals (0.027)	0.465**	0.544**	0.243	-0.001	0.02	-0.027*		-1.842*	1.829	
15-Metals (0.023)	-0.069	-0.02	-0.255*	-0.011	0.035*			1.087	-1.365	1.244
07-Plastics (0.020)	0.813**	0.299		-0.05**	-0.04**			2.055		
18-Photographic (0.01831)	0.993**	0.422**		0.025**	0.008	-0.009	-0.02**	-0.848*	-1.593**	
16-Machineries (0.00665)	0.692**	0.318**		0.043**				1.909		
12-Footwears (0.0043)	-0.207	-0.248	-0.118	0.079**	-0.028	-0.026	0.025	-1.654	-0.237	2.716
10-Pulps of Wood (0.0038)	0.816**	1.654**	0.770**	-0.11**	-0.06**			-1.358		
17-Vehicles (0.0031)	-0.242	-0.098	0.128	0.016	0.034	-0.025	-0.03	-7.00**	6.404	7.581**
03-Oils and Waxes (0.00213)	0.855**	0.537**	0.279**	0.03	-0.021	0.027	0.027	2.753	-1.781	
13-Stones and Cement (0.002)				0.030**				-0.861		
09-Woods (0.0018)	0.325	0.413**	0.175	0.031				1.527	0.555	-6.325**
19-Arms and Ammunition (0.0008)	-0.480*	-0.369*	-0.45**	-0.071	-0.074	0.316**		-1.093	-9.264	6.04
14-Culture Pearls (0.00065)	0.064	-0.370*	-0.37**	-0.18**	0.061	-0.071	0.207**	-6.452	14.809**	
20-Arts and Antique (0.00047)	-0.045	-0.034	0.291**	-0.28**	0.016	0.187**		-2.987		

Table 4.15 (Continued)

Industry (Trade Share)	Short-Run Coefficient Estimates								
	$\mathbf{LnFDI}_t$	$\mathbf{LnFDI}_{t-1}$	$\mathbf{LnFDI}_{t-2}$	$\mathbf{LnIR}_t$	$\mathbf{LnIR}_{t-1}$	$\mathbf{LnIR}_{t-2}$	$\mathbf{LnRT}_t$	$\mathbf{LnRT}_{t-1}$	$\mathbf{LnRT}_{t-2}$
11-Textiles (0.59)	-0.025			0.229	0.024	-0.566*	0.18**	0.005	-0.028
02-Vegetable (0.11)	0.054	0.013	-0.13**	1.176	-3.85**	-2.046	0.406	-1.985**	-0.89**
05-Minerals (0.05)	0.081	-0.007	-0.15**	0.576	0.643	-2.042	-0.396		
04-Foodstuff (0.052)	0.065			0.283	1.351		-0.288	1.241*	-0.016
08-Leather (0.04708)	-0.05**	0.055*	0.077**	-0.774	1.259*	-1.007*	0.085	0.179	-0.045
01-Live Animals (0.034)	0.029			-0.015			0.085	0.563**	0.484**
06-Chemicals (0.027)	0.047	0.072	-0.003	2.768**	-0.623		0.078	0.560*	0.092
15-Metals (0.023)	-0.27**	0.071	0.063	0.642**			-0.001	0.835**	
07-Plastics (0.020)	-0.104	0.185**	0.073	3.627**	-2.119	-1.615	0.655*	0.215	-0.84**
18-Photographic (0.01831)	0.057**	-0.046**	0.043*	0.595*	-0.812*		0.55**	-0.39**	
16-Machineries (0.00665)	-0.114	0.017	0.213**	0.118	3.491	-3.38**	-0.288		
12-Footwears (0.0043)	-0.120*	0.270**	0.098	2.605**	-0.195	-1.452	0.028	0.815**	-0.64**
10-Pulps of Wood (0.0038)	-0.39**	-0.099	-0.094	2.659	1.846	2.581	1.27**	2.57**	2.832**
17-Vehicles (0.0031)	-0.017	0.336**	0.111	-5.474*	3.227	-0.743	-0.554	1.088	1.530**
03-Oils and Waxes (0.00213)	-0.107	0.083	0.308**	-1.95	4.738*	-2.69**	0.15	0.292	1.778**
13-Stones and Cement (0.002)	0.037			1.038**			0.232		
09-Woods (0.0018)	0.074	-0.184*		-3.035*	4.294*	-2.436*	-0.28	-0.502	0.694
19-Arms and Ammunition (0.0008)	-0.455	-0.527*	-0.262	-0.073	3.174	-15.0**	0.561		
14-Cultured Pearls (0.00065)	-0.376	0.446*	-0.152	6.34*			0.945		
20-Arts and Antique (0.00047)	-0.082	-0.073	0.531**	1.125	-1.5	-3.994	-0.275	-3.781**	3.763**

Table 4.15 (Continued)

Industry (Trade Share)	Short-Run Coefficient Estimates						
	$\mathbf{LnINF}_t$	$\mathbf{LnINF}_{t-1}$	$\mathbf{LnINF}_{t-2}$	$\mathbf{LnIP}_t$	$\mathbf{LnIP}_{t-1}$	$\mathbf{LnIP}_{t-2}$	$\mathbf{ECM}_{t-1}$
11-Textiles (0.59)	0.907*	-1.680**		0.215**	0.11**		-0.64** (-5.77)
02-Vegetable (0.11)	-0.7	-10.65**	8.664*	0.105	-0.107	-0.043	-3.76** (-4.40)
05-Minerals (0.05)	7.776**	-4.23	-3.359	0.294	0.251	-0.79**	-1.94** (-6.08)
04-Foodstuff (0.052)	15.61**	3.189	-19.2**	0.101	1.02**	-0.419	-0.68** (-2.13)
08-Leather (0.04708)	4.412**			0.263**			-0.98** (-7.84)
01-Live Animals (0.034)	1.604	-8.481**		0.056			-0.65** (-3.73)
06-Chemicals (0.027)	-1.538	0.333	-3.129	0.252	0.326*		-1.85** (-5.77)
15-Metals (0.023)	1.15			0.039			-0.74** (-3.31)
07-Plastics (0.020)	-1.436	-3.103	2.895	0.245	-0.197	0.79**	-1.66** (-4.46)
18-Photographic (0.01831)	1.219	0.235	1.489*	-0.171*			-2.47** (-9.89)
16-Machineries (0.00665)	-0.496	-8.149**		-0.72**	0.134	-0.276	-1.91** (-6.06)
12-Footwears (0.0043)	3.66*	-0.707	-0.054	-0.018	-0.199	0.082	-1.37** (-5.63)
10-Pulps of Wood (0.0038)	-16.9**	-9.454	13.92**	0.172	0.063	-0.484	-1.46** (-6.21)
17-Vehicles (0.0031)	23.81**	-2.522	-19.3**	-0.218	0.264	-0.638	-1.37** (-3.14)
03-Oils and Waxes (0.00213)	5.73**			-0.83**	0.523	-0.62**	-1.81** (-5.93)
13-Stones and Cement (0.002)	4.468**			-0.054			-0.94** (-6.22)
09-Woods (0.0018)	4.197**			0.367	0.44	-0.782*	-1.05** (-3.57)
19-Arms and Ammunition (0.0008)	-0.378	20.42		0.656	-1.028	3.59**	-0.70** (-2.46)
14-Cultured Pearls (0.00065)	8.546*			0.779	3.08**	-1.418	-0.87** (-2.63)
20-Arts and Antique (0.00047)	28.72**			-0.76**			-0.77** (-4.11)

*A. **indicate significance level at 5%. *indicate significance level at 10%. B. The complete description of each industry is provided in Table 4.12. C. V=Exchange rate uncertainty, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. D. The t-ratio values are given in the parentheses next to ECM_{t-1}. The t-ratio upper bound critical values at 5% (1%) significance level when number of exogenous variables are seven (k=7) are -4.57 (-5.19) and lower bounds are -2.86(-3.43). These values are from Pesaran et al. (2001) Table C 02, case III, and page number 38.*

4.3.4.4 Short-Term Relationship Between Exchange Rate and Industry-Level Export

Now the short run estimates of export based model are reported in Table 4.15. Where first three lagged level coefficients of export demand are given.It is obvious that there are 17 industries where at least one lagged level coefficient of export demand is significant. However, the signs of these coefficients are mixed up some positive and others negative, thereby suggesting different behaviour of industries at individual level. As for the effect of exchange rate uncertainty twelve industries coded 05, 04, 08, 07, 18, 16, 12, 10, 13, 19, 14, and 20 carries short-term significant coefficients, where six industries 04, 08, 16, 16, 12, 13, and 19 have positive coefficients three industries 05, 07, and 10 negative estimates. In the first group two are the largest of exporting industries which are 05 (Mineral Products, 5.3% market share) and 08 (Raw Hide and Skins, Leather, Fur skins and Articles thereof, 4.7% market share), while the remaining are relatively small industries. It is to be noted three small industries numbered 18, 14, and 20 carries significant mix of negative and positive coefficients. Some industries, positive coefficients, export more in case of higher volatility and others, negative coefficients, export less in time of higher volatility. Thus, thereby suggesting varying behavior to volatility of industries at individual level. Moving toward 10% significance level three more industries coded 11, 06, and 15 estimates becomes significant.

The nominal exchange rate as expected carries at least one significant positive coefficient in five industries numbered as 11, 02, 04, 01, and 14, implying that as rupee depreciate Pakistan exports more of these commodities. On the other hand, three of the industries 06, 18, and 09 carries negative significant coefficients, demonstrating that these industries export less in response to rupee depreciation. In the above industries 11, 02, and 06 are significant at 10% significance level.

As for the effect of FDI, results reveal that twelve industries carries significant coefficients coded 02, 05, 08, 15, 07, 18, 16, 12, 10, 17, 03, and 20. Where half of the industries in short run export more in periods of high FDI and remaining half industries coded 02, 05, 15, 18, and 10 carries significant negative short-run coefficients suggesting that higher FDI in PAk discourage the exports of these

sectors. In the second group of significant negative coefficients there are two of the largest exporting industries coded 02 (Vegetable Products, 11% market share) and 05 (Mineral Products, 5.3% market share), while the remaining and industries in the first group are relatively small in size. It is to be given that 09, 19, and 14 industries are additionally significant coefficients when the significance level is 10%.

Moreover, real interest rate have nine short-term significant coefficients, out of which six industries 06, 15, 07, 12, 13, and 14 carries positive and remaining half of industries 11, 02, 16, 17, 03, and 19 show negative coefficients. The industries 11(Textiles and Textile Articles, 0.59) and (Vegetable Products, 0.11) have largest market share among all the exporting industries, demonstrating that a higher interest rate discourage production activity in the country thus, the export volume decline. Of the above significant results industries coded 11, 08, 18, 17, 09, and 14 one of the short run estimates are significant at 10% significance level.

The remittances carries its short-term significant estimates in eleven industries coded 11, 02, 01, 15, 07, 18, 12, 10, 17, 03, and 20, implying that a higher flow of remittances effect Pakistan short-term exports volume. The significant estimates are positive in six industries coded 11, 01, 15, 10, 17, and 03, suggesting that a rise in flow of remittances, Pakistan exports more of these commodities. While on the other hand two sectors coded 02 and 07 respond negatively to higher remittances. The three relatively small sectors coded 18, 12, and 20 indicate varying behaviour to the volume of remittances, since the short-term coefficients are mix of positive and negative significant coefficients.

When inflation increases in the short run nine industries coded 05, 08, 18, 12, 03, 13, 09, 14, and 20 export more while other four industries 11, 02, 01, and 16 export less to the world. It is obvious from the above results that two largest industries 11 (Textiles and Textile Articles) and 02 (Vegetable Products) with 59% and 11% market share respectively, exports less when the rate of inflation in the country increased. While three industries coded 04, 10, and 17 carry coefficients positive on some and negative on other lags suggesting varying behaviour of short-term export demand to inflation rate in Pakistan.

As for the growing economic activity in Pakistan, in the short run the export of seven industries coded 11, 4, 08, 06, 07, 19, and 14 increases, as indicated by the positive significant coefficients attached to that. Conversely, industries numbered 05, 18, 16, 03, 09, and 20 are attached with negative significant coefficients implying that a growing economic activity leads to a fall in exports of these commodities. The first group covers one of the largest industry 11 (Textiles and Textile Articles) among all exporting industries with 59% market share whose exports expands when economic activity grows.

Then the error correction specifications are introduced in equation (4) of linear industry level export based model to further check for the long-term cointegration. The cointegration exist when the ECM_{t-1} carries significant negative coefficients, by following Pesaran et al. (2001) further suggest that the value of t-ratio should also be greater than the specified upper bound. The coefficients of ECM_{t-1} are negatively significant in all 20 exporting industries, demonstrating the existence of cointegration in all industries. By following the -4.57 t-ratio upper bound at 5% significance level of Pesaran et al. (2001), all the null hypothesis of no cointegration rejected except three small industries coded 04, 19, and 14.

TABLE 4.16: Coefficient Estimates of Linear Import Model

Industry (Trade Share)	**Long-run Coefficient Estimates**									
	Constant	**LnV**$_t$	**LnNEX**$_t$	**LnFDI**$_t$	**LnIR**$_t$	**LnRT**$_t$	**LnINF**$_t$	**LnIP**$_t$	**F-Stat.**	**Adj. R**^{2}
5-Minerals (0.255)	71.76**	0.022	1.682	-0.111*	-0.869	-0.049	11.52**	0.662**	26.55**	0.939
16-Machineries (0.16)	15.53**	-0.021**	-1.16**	0.129**	0.860*	-0.324*	0.96	0.111*	48.81**	0.961
06-Chemicals (0.11)	13.69**	0.001	0.604	-0.066*	0.839	0.259	3.105**	0.104	23.14**	0.906
15-Metals (0.085)	21.94**	-0.012	-0.532	0.018	1.23**	-0.041	-0.164	-0.063	37.62**	0.941
11-Textiles (0.075)	18.55**	-0.041*	0.092	-0.024	-1.829	-1.07**	-0.982	0.238**	19.98**	0.868
2-Vegetables (0.06)	7.318	-0.06**	-4.31**	-0.007	2.973**	-0.142	2.263	-0.51**	16.36**	0.883
17-Vehicles (0.06)	8.22**	-0.03**	0.785	-0.001	2.065**	-0.259	1.215	-0.15**	24.73**	0.896
07-Plastics (0.052)	62.96**	-0.039**	0.04	-0.085	-2.39**	0.156	4.196**	0.435*	43.11**	0.971
03-Oils and Waxes (0.043)	12.65**	0.014	-1.681*	-0.193**	0.180**	-0.297	10.31**	0.036	72.13**	0.925
20-Arts and Antiques (0.038)	50.78**	-0.1	-7.78**	0.099	-0.692	-1.547	5.43	-0.115	3.036**	0.55
10-Pulps of Wood (0.0158)	34.26**	0.033**	-1.57**	-0.094**	1.681**	-0.043	3.003**	0.297**	39.09**	0.953
18-Optical and Photographic (0.02)	51.14**	0.026*	1.594**	0.075	-3.37**	0.079	1.109	0.061	27.41**	0.926
04-Foodstuffs (0.012)	-24.59**	0.02	1.25	0.478**	2.843**	1.134	-23.92**	0.632	5.74**	0.655
13-Stones and Cement (0.006)	11.62**	-0.025**	-0.329	0.058*	-0.935*	-0.293	1.247*	0.109**	74.62**	0.955
01-Live Animals (0.004587)	2.962	0.002	1.915	-0.15	0.772**	0.933*	-9.49**	0.283**	38.46**	0.916
09-Woods (0.0035)	15.69**	-0.037*	0.184	0.043	2.461**	-0.94**	-3.58*	-0.359	29.17**	0.941
08-Skins and Leather (0.0018)	33.06**	0.053	0.969	-0.131	-3.22**	-0.419	6.44**	1.224**	5.72**	0.673

Table 4.16 (Continued)

Industry (Trade Share)	Long-run Coefficient Estimates									
	Constant	**LnV$_t$**	**LnNEX$_t$**	**LnFDI$_t$**	**LnIR$_t$**	**LnRT$_t$**	**LnINF$_t$**	**LnIP$_t$**	**F-Stat.**	**Adj. R^2**
12-Footwears & Umbrellas(0.0016)	-5.061	-0.025	2.377	-0.083	-2.76**	0.322	3.16**	0.034	57.2**	0.955
19-Arms and Ammunition (0.0014)	-6.83	-0.048	0.785	0.358	4.43	-0.751	16.28**	-0.720**	3.61**	0.412
14- Precious Stones (0.000172)	-38.14**	-0.156**	-4.705	0.048	-0.444	2.115	1.935	0.605	3.46**	0.413

***indicate significance level at 5%, respectively. *indicate significance level at 10%, respectively. B. V=Exchange rate volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. C. at the 5% (1%) significance level when the number of explanatory variables are seven (K=7) the F-Statistics Lower bound critical values are 2.32 (2.96) and upper bounds critical values are 3.50 (4.26). These bound critical values are taken from Pesaran et al. (2001) Table CI Case III, Page number 36. D. 05-Mineral Products, 16-Machinery and Mechanical Appliances, 06-Products of Chemical or Allied Industries, 15-Base Metals and Articles or Base Metal, 11-Textiles and Textile Articles, 02-Vegetable Products, 17-Vehicles, Aircraft, Vessels and Associated Transport Equipment, 07-Plastics and Articles thereof; Rubber and Articles thereof, 03-Animal or Vegetable Fats, Oils and Waxes, 20-Works of Arts, Collectors, Pieces, Antiques and Special Transactions NES, 10-Pulp of Wood or of other Fibrous Cellulosic Material, 18-Optical, Photographic, Cinematographer, Measuring, Precision Apparatus, 04-Prepared Foodstuffs; Beverages, Spirits, Vinegar and Tobacco, 13-Articles of Stone, Plaster, Cement, Asbestos, Mica or similar Materials, 01-Live Animals and Animals Products, 09-Wood and Articles of Wood, 08-Raw Hide and Skins, Leather, Fur skins and Articles thereof, 12-Footwear, Headgear, Umbrellas, Walking Sticks etc., 19-Arms and Ammunition, Parts and Accessories thereof, 14-Natural or Cultured Pearls, Precious or Semi-Precious Stones, Metals.*

4.3.5 Linear Relationship Between Exchange Rate and Industry Level Import

4.3.5.1 Basic Industry-Level Import Based Model

Next, the discussion are turned to the estimates of ARDL linear import based model. It is evident form the basic estimates in Table 4.16 that Volatility carries significant negative coefficients in eight industries coded 16, 11, 02, 17, 07, 13, 09, and 14. While two industries coded 10 and 18 the coefficients are positively significant. The first group covers the five largest market share Pakistan importing industries that are 16 (Machinery and Mechanical Appliances, 0.162), 11 (Textiles and Textile Articles, 0.075), 02 (Vegetable Products, 0.059), 17 (Vehicles, Aircraft, Vessels and Associated Transport Equipment, 0.059), and 07 (Plastics and Articles thereof; Rubber and Articles thereof, 0.052), implying that in time of high exchange rate uncertainty Pakistan imports less of these products. It is to be mentioned that industries coded 11, 18, and 09 are significant at 90% confidence level.

An inflating exchange rate discourage the imports of four industries coded 16, 02, 03, 20, and 10, while only one small industry 18 with market share of just 1.5% imports grows in response to rupee depreciation. The negative significant estimates demonstrate that rupee depreciation discourage Pakistan imports. The foreign direct investment carries significant positive estimates in industries coded 16, 04, and 13 while the following industries coded 05, 06, 03, and 10, attached to as expected significant negative coefficients. The second group contain two of the largest industries 05 (Mineral Products, 25% market share) and 06 (Products of Chemical or Allied Industries, 11% market share), implying that as FDI decline Pakistan imports more of these products.

Moreover, real interest have significant coefficients in twelve industries coded 15, 02, 17, 07, 03, 10, 18, 04, 01, 09, 08, and 12. Where 07, 18, 13, 08, and 12 coded industries carries significant negative coefficients and industries coded 16, 15, 02, 17, 03, 10, 04, 01, and 09 attached to significant positive coefficients, suggesting that a rise in real interest rate decline economic activity thus the demand for

imports boost. As the flow of remittances rise in the country three industries coded 16, 11 and 09 reduce imports while industry 01 improves the imports. As the general price level increases the import of industries coded 05, 06, 07, 03, 10, 13, 08, 12, and 19 significantly improves while that of industries coded 04, 01, and 09 imports are negatively affected. The two industries coded 13 and 09 coefficients are significant at 90% confidence level.

As for the growing economic activity in Pakistan, the imports of industries coded 05, 16, 11, 07, 10, 13, 01, and 08 are significantly improves while the imports of industries coded 02, 17, and 19 are negatively affected. The industries whose imports are improved in response to growing economic activity are relatively large industries like industry 05 (Mineral Products) and industry 16 (Machinery and Mechanical Appliances) with 25% and 16% market share respectively. The two of the above industries coded 16 and 07 are significant at 10% significance level.

In all sectors the F-statistic value is significantly greater than the Pesaran et al. (2001) upper bound critical value of 3.50 supporting the alternative hypothesis of cointegration except for two sectors coded 20 and 14 where the F-statistic value is between the lower and upper bounds critical values leading to inconclusiveness of results that whether cointegration exist or not. A measure of goodness, Adj.R^2 estimates are reported in Table 4.16 that explain the variability of import based models.

TABLE 4.17: Diagnostic Statistics Associated with Table 4.16 (Linear Import Based Model)

Industry (Trade Share)	Diagnostic Statistics						
	Bound	**Wald Test**	**Jarque-Bera**	**LM**	**RESET**	**CUM**	**CUMQ**
5-Minerals (0.255)	6.82**	26.55**	2.196	2.198	0.389	S	S
16-Machineries (0.16)	7.80**	48.81**	0.315	1.312	0.179	U	S
06-Chemicals (0.11)	5.93**	23.14**	1.144	0.354	0.126	S	S
15-Metals (0.085)	6.13**	37.62**	2.062	1.3382	0.265	S	S
11-Textiles (0.075)	3.71**	19.98**	0.395	1.206	3.77	S	S
2-Vegetables (0.06)	9.84**	16.36**	7.110**	1.596	0.181	S	S
17-Vehicles (0.06)	6.48**	24.73**	1.978	2.75	2.499	S	S
07-Plastics (0.052)	4.82**	43.11**	0.1	0.684	1.852	S	U
03-Oils and Waxes (0.043)	6.70**	72.13**	0.64	0.565	2.455	S	S
20-Arts and Antiques (0.038)	4.10**	3.035**	0.898	1.422	3.896	S	U
10-Pulps of Wood (0.0158)	3.56**	39.09**	1.235	2.873**	0.317	U	U
18-Optical and Photographic (0.02)	10.12**	27.41**	1.98	2.717	0.949	S	S
04-Foodstuffs (0.012)	4.33**	5.74**	0.091	1.136	0.158	S	S
13-Stones and Cement (0.006)	9.21**	74.62**	0.007	0.458	1.123	S	S
01-Live Animals (0.004587)	14.85**	38.46**	0.455	0.8007	6.66	S	S
09-Woods (0.0035)	4.46**	29.17**	0.341	2.313	1.49	S	U
08-Skins and Leather (0.0018)	3.64**	5.72**	22.0**	1.139	9.14**	S	S
12-Footwears & Umbrellas(0.0016)	5.31**	57.21**	4.19	2.137	0.807	S	S
19-Arms and Ammunition (0.0014)	6.90**	3.61**	1.54	2.048	0.302	S	S
14- Precious Stones (0.000172)	7.84**	3.46**	1.08	3.419	0.497	S	S

*A. **indicate significance level at 5%. *indicate significance level at 10%. B. Trade share is the percentage of Proportionate Share of each industry in the total trade over the sample period. C. Bound is the is the model stability test. Jarque-Bera is the goodness-of-fit test for the sample normality. LM is the residual serial correlation test stands for Lagrange Multiplier and with one degree of freedom is distributed as X^2. REST is the Ramseys reset test for the model misspecification it is also denoted by X^2 with one degree of freedom. CU and CUQ shows Cumulative sum and cumulative sum square tests for the stability of the Model and indicated by S for stable and U for unstable at 5% significance level. The complete description of each industry is given in the Tablenotes of Table 4.16*

4.3.5.2 Diagnostics Tests for Industry-Level Import Based Model

The battery of diagnostics are performed to check the suitability of the linear import based model, those reported in Table 4.17. All 20 importing industries estimates attached to bound test are highly significant and exceeds upper bound critical value at 5% significance level supporting model stability. Then Wald test is applied that carries significant estimates further confirming the existence of cointegration in all models. Thereafter, for normality testing of data Jarque-Bera test is performed indicating just in two industries coded 02 and 08 the data is not normally distributed. The optimum models do not suffer from serial correlation except a small sector where LM caries significant coefficient. All the models are well specified except of industry 08 as calculated through Ramseys RESET test. Finally for stability diagnostics CUM and CUQ test are performed. The results are stable of all cumulative sum test expressed by S, while that in cumulative sum square industries coded 07, 20, 10, and 09 stability is not there indicated by U. For such unstable models the dummy variable is used to achieve model stability.

TABLE 4.18: Long-Run Coefficient Estimates of Linear Import Model

Industry (Trade Share)	**Long-Run Coefficient Estimates**							
	Constant	**LnV**$_t$	**LnNEX**$_t$	**LnFDI**$_t$	**LnIR**$_t$	**LnRT**$_t$	**LnINF**$_t$	**LnIP**$_t$
5-Minerals (0.255)	40.75**	-0.002	0.758	-0.429**	0.624**	-3.076**	2.574**	0.398**
16-Machineries (0.16)	13.08**	0.023**	-1.218*	0.295**	-0.393**	-0.273*	1.022	0.094**
06-Chemicals (0.11)	11.25**	0.001	0.497	-0.149**	0.224**	0.304	-0.675	0.124**
15-Metals (0.085)	19.11**	0.035**	-0.463	0.016	-0.144	-0.720*	0.764	0.211**
11-Textiles (0.075)	20.03**	-0.044*	1.255	-0.026	-0.685**	-1.155*	0.525	0.257**
2-Vegetables (0.06)	4.087	-0.014	-7.62**	0.413**	-0.502**	-0.562	8.25**	-0.284**
17-Vehicles (0.06)	11.26**	-0.095**	-3.317**	0.291**	-0.302**	-1.70**	6.79**	-0.203**
07-Plastics (0.052)	15.80**	-0.007	-0.075	-0.123**	-0.156**	-0.304	0.274	0.191**
03-Oils and Waxes (0.043)	16.54**	0.018	-3.44**	-0.253**	0.235**	-0.389	3.212**	0.048
20-Arts and Antiques (0.038)	23.56**	-0.047	-3.61**	0.101	-0.478	-1.737	4.92**	0.043
10-Pulps of Wood (0.0158)	15.18**	0.015**	-1.753**	-0.041**	0.093*	-0.492**	1.732**	0.130**
18-Optical and Photographic (0.02)	26.99**	0.052**	0.841**	0.04	-0.86**	-1.66**	0.585	0.286**
04-Foodstuffs (0.012)	-15.83**	0	0.8	0.56**	1.83**	0.73	0.65	-0.2
13-Stones and Cement (0.006)	11.84**	-0.004	-1.715**	0.059*	-0.927**	-0.09	1.270*	0.111**
01-Live Animals (0.004587)	2.103	-0.021	-1.588	-0.107	0.548**	0.663*	0.534	0.201**
09-Woods (0.0035)	5.85**	-0.044**	-2.791**	0.082**	-0.226**	-0.350**	3.595**	-0.03
08-Skins and Leather (0.0018)	49.69**	0.137**	1.457	-0.837**	-0.009	-2.449	-1.437	0.743**
12-Footwears & Umbrellas(0.0016)	-2.894	-0.036*	-0.112	-0.048	-0.414**	0.184	1.810**	0.02
19-Arms and Ammunition (0.0014)	-6.329	0.074	-7.259	1.419**	-1.019**	-3.59*	15.08**	-0.667**
14- Precious Stones (0.000172)	-34.08**	-0.140**	-4.204	0.803**	-0.396	1.89	4.555	-0.515**

*A. **indicate significance level at 5%, respectively. *indicate significance level at 10%, respectively. B. V=Exchange rate volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. C. Trade share is the percentage proportionate share of each industry in the total trade over the sample period. D. The particulars of each industry is given in the table notes of Table 4.16.*

4.3.5.3 Long-Term Relationship Between Exchange Rate and Industry-Level Import

The long-term coefficients estimates of linear import based model are reported in Table 4.18. To start with exchange rate volatility that carries eight significant coefficients in industries coded 16, 15, 17, 10, 18, 09, 08, and 14 additionally two more significant results at 90% confidence level in industries 11 and 12. As for the higher volatility in exchange rate industries coded 11, 09, 12, and 14 are attached to negative significant estimates including one larger industry 11 (Textiles and Textile Articles) having market share of 7.5%. On the other side in times of higher exchange rate volatility Pakistan imports more of commodities of industries numbered 16, 15, 17, 10, 18, and 08. Where first three are the big sized industries that are 16 (Machinery and Mechanical Appliances, 16% market share), 15 (Base Metals and Articles or Base Metal, 8.5% market share), and 17 (Vehicles, Aircraft, Vessels and Associated Transport Equipment).

A rising nominal exchange rate boost the imports of eight industries coded 02, 17, 03, 20, 10, 18, 13, and 09, implying that rupee depreciation encourage these industries to imports more. Conversely, only industry 18 (Optical, Photographic, Cinematographer, Measuring, Precision Apparatus) a relatively small industry decrease imports as a result of rupee depreciation.

The rising flow of FDI in Pakistan improves the imports of seven industries 16 (Machinery and Mechanical Appliances, 0.162), 02 (Vegetable Products, 0.06), 17 (Vehicles, Aircraft, Vessels and Associated Transport Equipment, 0.058), 04, 09, 19, and 14. While that of industries numbered 05 (Mineral Products, 0.255), 06 (Products of Chemical or Allied Industries, 0.11), 07 (Plastics and Articles thereof; Rubber and Articles thereof, 0.052), 03, 10, and 08 carries significant negative coefficients, demonstrating that a higher FDI into the country discourage imports demand of the following products.

The real interest rate carries fifteen significant coefficients of which five industries coded 05, 06, 03, 04, and 01 attached to positive estimates and ten industries coded 16, 11, 02, 17, 07, 18, 13, 09, 12, and 19 carries significant negative coefficients,

implying that a higher interest rate discourage purchasing power so the imports of mentioned commodities reduced.

In Pakistan when the volume of remittances rises the volume of imports declining as indicated by the significant negative coefficients in industries coded 05, 16, 15, 11, 17, 10, 18, 09, and 19. The only small industry imports improves when there is high inflow of foreign remittances in Pakistan. It is to be mentioned that the following five 16, 15, 11, 01, and 19 industries coefficients are significant at 10% significance level.

The long-term positive significant estimates attached to Ln INF in nine industries numbered 05, 02, 17, 03, 20, 10, 09, 12, and 19 indicate that in inflationary period these industries imports more to the country because the domestic economic activity is negatively affected.

Finally, the growing industrial production in Pakistan significantly improves the imports of eleven industries coded 05, 16, 06, 15, 11, 07, 10, 18, 13, 01, and 08 as carries positive coefficients. But the following industries coded 02 (Vegetable Products, 0.06), 17 (Vehicles, Aircraft, Vessels and Associated Transport Equipment, 0.058), 19, and 14 imports are decline when the economic activity grows in the country. As cleared from the Table 4.18, on the basis of market share the first five industries of positive significant coefficients are the largest of all Pakistan importing industries.

TABLE 4.19: Short-Run Coefficient Estimates of Linear Import Model

Industry (Trade Share)	**Short-Run Coefficient Estimates**									
	LnDV$_{t-1}$	**LnDV**$_{t-2}$	**LnDV**$_{t-2}$	**LnV**$_t$	**LnV**$_{t-1}$	**LnV**$_{t-2}$	**LnV**$_{t-3}$	**LnNEX**$_t$	**LnNEX**$_{t-1}$	**LnNEX**$_{t-2}$
5-Minerals (0.255)	0.523**	0.267	0.256*	0.022	-0.022	0.040**	0.031	1.682	5.648**	-1.445
16-Machineries (0.16)	0.448**	0.397**		-0.02**	0.018*	-0.03**	-0.014	-1.165**	2.370**	-2.044**
06-Chemicals (0.11)	0.003	0.001		0.039	0.079	0.001	0.199	0.054	0.019	0.033
15-Metals (0.085)	0.185			-0.012	-0.005	-0.02	-0.03**	-0.532		
11-Textiles (0.075)	0.183			-0.041*				0.092	5.456**	-5.605**
2-Vegetables (0.06)	0.517**	-0.027	-0.263*	-0.06**	0.009	-0.028	-0.029	-4.31**	4.578**	-2.275
17-Vehicles (0.06)				-0.03**	0.04**			0.785		
07-Plastics (0.052)	2.24**	0.893**	0.411	-0.04**	-0.018	0.011	0.025*	0.04	1.688	1.801
03-Oils and Waxes (0.043)				0.014				-1.68**		
20-Arts (0.038)	0.827**	0.848**	0.432*	-0.1				-7.787**		
10-Pulps of Wood (0.0158)	1.08**	0.635**	0.253*	0.033**				-1.568**	0.242	0.601
18- Photographic (0.02)	0.568**	0.349**		0.026*	-0.005	-0.029*	-0.04**	1.594**		
04-Foodstuffs (0.012)	1.033**	0.482**		0.02	0.15**	0.033	-0.14**	1.25		
13-Stones and Cement (0.006)				-0.03**				-0.329	1.283**	
01-Live Animals (0.004587)				0.002	0.036	0.041	-0.07**	1.915	-1.644	3.451**
09-Woods (0.0035)	1.22**	0.599**	0.322*	-0.037*	0.055**			0.184	0.092	1.267
08-Skins and Leather (0.0018)	-0.162			0.053	-0.013	-0.081**	0.038	0.969		
12-Footwears (0.0016)	0.38	-0.079	-0.243*	-0.025	-0.06**	0.046	0.045*	2.377	-2.117	4.543**
19-Arms and Ammunition (0.0014)				-0.048				0.785		
14-Cultured Pearls (0.00017)				-0.16**				-4.705		

Table 4.19 (Continued)

Industry (Trade Share)	Short-Run Coefficient Estimates								
	$\mathbf{LnFDI}_t$	$\mathbf{LnFDI}_{t-1}$	$\mathbf{LnFDI}_{t-2}\mathbf{LnIR}_t$		$\mathbf{LnIR}_{t-1}$	$\mathbf{LnIR}_{t-2}$	$\mathbf{LnRT}_t$	$\mathbf{LnRT}_{t-1}$	$\mathbf{LnRT}_{t-2}$
5-Minerals (0.255)	-0.111*	0.267**	0.002	-0.869			-0.049	1.289**	0.780**
16-Machineries (0.16)	0.129**	-0.004	-0.037	0.860*			-0.324*		
06-Chemicals (0.11)	0.001	0.917	0.239	0.071			0.082		
15-Metals (0.085)	0.018			1.234**			-0.041	0.481**	-0.394*
11-Textiles (0.075)	-0.024			-1.829	0.477	-2.29**	-1.07**		
2-Vegetables (0.06)	-0.007	-0.162**	-0.12	2.97**			-0.142	0.854**	
17-Vehicles (0.06)	-0.001	-0.045	-0.09**	2.065**			-0.259		
07-Plastics (0.052)	-0.085	0.263**	0.115**	-2.39**	1.121	-0.899	0.156	0.308	0.133
03-Oils and Waxes (0.043)	-0.19**			0.180**			-0.297		
20-Arts (0.038)	0.099	-0.298*	0.379**	-0.692	0.402	-1.405	-1.547	-0.679	1.268
10-Pulps of Wood (0.0158)	-0.09**			1.681**	-1.51**		-0.043	0.633**	-0.894**
18- Photographic (0.02)	0.075			-3.37**	1.766	2.874**	0.079	1.292**	0.405
04-Foodstuffs (0.012)	0.478**			2.843**			1.134		
13-Stones and Cement (0.006)	0.058*			-0.935*	1.196**		-0.293	0.332*	-0.361**
01-Live Animals (0.00458)	-0.15			0.772**			0.933*		
09-Woods (0.0035)	0.043	-0.104*		2.46**	2.736	-2.33*	-0.939*		
08-Skins and Leather (0.0018)	-0.131	0.037	0.295**	-3.22**			-0.419	0.48	0.837*
12-Footwears (0.0016)	-0.083			-2.77**	3.96**		0.322		
19-Arms and Ammunition (0.0014)	0.358	-0.63**	- 0.567**	4.43			-0.751		
14-Cultured Pearls (0.00017)	0.048	-0.434**		-0.444			2.115		

Table 4.19 (Continued)

Industry (Trade Share)	Short-run Coefficient Estimates						
	$\mathbf{LnINF}_t$	$\mathbf{LnINF}_{t-1}$	$\mathbf{LnINF}_{t-2}$	$\mathbf{LnIP}_t$	$\mathbf{LnIP}_{t-1}$	$\mathbf{LnIP}_{t-2}$	$\mathbf{ECM}_{t-1}$
5-Minerals (0.255)	11.52**			0.662**	0.049	0.019	-1.76** (-6.39)
16-Machineries (0.16)	0.96	-4.448**	4.143**	0.111*			-1.18** (-7.74)
06-Chemicals (0.11)	0.326	0.01	0.021	0.08			0.00(-5.57)
15-Metals (0.085)	-0.164	1.786	-2.729*	-0.063	-0.022	0.274	-1.15** (-6.38)
11-Textiles (0.075)	-0.982	-7.066	-0.49	0.238**			-0.93** (-4.43)
2-Vegetables (0.06)	2.263			-0.51**			-1.79** (-6.68)
17-Vehicles (0.06)	1.215	0.175	-4.502**	-0.15**			-0.73** (-5.41)
07-Plastics (0.052)	4.196**	3.619	-3.183	0.435*	0.21	0.09	-3.98** (-4.92)
03-Oils and Waxes (0.043)	10.32**			0.036			-0.76** (-7.47)
20-Arts (0.038)	5.435	-5.23	-10.073	-0.115	-0.18	-0.664	-2.15** (-4.71)
10-Pulps of Wood (0.0158)	3.003*	-1.407	1.651	0.297**	-0.071	-0.24*	-2.26** (-5.99)
18- Photographic (0.02)	1.109			0.061	0.183	-0.145	-1.89** (-9.01)
04-Foodstuffs (0.012)	-23.9**	14.48*	-19.7**	0.632	-1.136	0.721	-1.55** (-5.56)
13-Stones and Cement (0.006)	1.247*			0.109**			-0.98** (-7.96)
01-Live Animals (0.00458)	-9.49**			0.283**			-1.41** (-11.42)
09-Woods (0.0035)	-3.587*	-2.135	-8.94**	-0.359	-0.212		-2.68** (-6.24)
08-Skins and Leather (0.0018)	6.44**	-4.571	7.77**	1.22**			-0.66** (-4.08)
12-Footwears (0.0016)	3.164**			0.034			-1.75** (-5.15)
19-Arms and Ammunition (0.0014)	16.29**			-0.72**			-1.08** (-7.49)
14-Cultured Pearls (0.00017)	1.935	-11.009	23.29**	0.605	0.505	-0.897	-1.12** (-8.25)

*A. **indicate significance level at 5%. *indicate significance level at 10%. B. Trade share is the percentage proportionate share of each industry in the total trade over the sample period. C. V=Exchange rate volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. D. The t-ratio values are given in the parentheses next to ECM_{t-1}. The t-ratio upper bound critical values at 5% (1%) significance level when number of exogenous variables seven (k=7) are -4.57 (-5.19) and lower bounds are -2.86(-3.43). These values are taken from the Pesaran et al. (2001) Table C 02, case III, and page number 38.*

4.3.5.4 Short-Term Relationship Between Exchange Rate and Industry-Level Import

The short-term coefficients estimates of linear ARDL import based model are reported in Table 4.19. The lagged variables of import demand have significant positive estimates in industries coded 05, 16, 02, 07, 20, 10, 18, 04, and 09, implying itself adjustments in the subsequent quarters.

The exchange rate volatility carries at least one short-term significant coefficient in sixteen industries identified as 05, 16, 15, 02, 17, 07, 10, 18, 04, 13, 01, 09, 08, 12, and 14. From the significant industries six industries coded 05, 16, 15, 10, 13, and 09 attached positive coefficients suggesting that exchange rate uncertainty tend these industries to import more of these products. While in the remaining eight industries coded 02, 17, 07, 18, 01, 08, 12, and 14 the coefficients are significant and negative, whose imports are adversely affected by exchange rate volatility. Included in the first group are two largest importing industries 05 (Mineral Products, 25% market share), and 16 (Machinery and Mechanical Appliances, 16% market share), whose imports are favorably affected by exchange rate volatility. The remaining industries are relatively small. Further, one largest industry 11 (Textiles and Textile Articles with 7.5% market share) is negatively significant at 90% confidence level. It is to be noted that industry 04 (Prepared Foodstuffs; Beverages, Spirits, Vinegar and Tobacco, 0.012) carries mix of positive and negative short term coefficients.

Thereafter, nominal exchange rate carries at least one significant positive coefficient in five industries coded 05, 18, 13, 01, and 12, implying that when rupee depreciate Pakistan import more of these products. Conversely, exchange rate attached to at least one significant short-term negative coefficient in three industries 03, 20, and 10, indicating a rupee depreciation discourage imports of these products. The first group include one largest industry 05 (Mineral Products with 25% market share). The three industries 16, 11, and 02 attached significant mix of positive and negative coefficients at different lag times.

As for the rising foreign direct investment in Pakistan industries coded 16, 07, 13, and 08 import more of these products, as indicated by significant positive coefficients. On the other hand, the FDI carries significant negative coefficients in seven industries numbered 02, 17, 03, 10, 09, 19, and 14, demonstrating as FDI increase Pakistan imports less of these commodities. Here again two industries 05 and 20 have mix negative and positive short term coefficients.

A higher real interest rate in Pakistan will grow the imports of industries coded 16, 15, 02, 17, 03, 04, and 01, while discourage the imports of three industries 11, 07, and 08, as indicated by significant positive and significant negative coefficients respectively. The real interest rate carries short run negative and positive coefficients at different lags in industries coded 10, 18, 13, 09, and 12.

Remittances are inflows transferred by the residents of a country working abroad. When Pakistan flow of remittance improves industries coded 05, 02, 18, 01, and 08 imports more to Pakistan to meet the growing demand, as directed by the positive coefficients attached to Ln RT. Conversely, a rising flow of remittance in short run discourage the following three industries 16, 11, and 09 to import presented by the negative significant coefficients. Three industries coded 15, 10, and 13 have short term mix of significant positive and negative estimates, suggesting a varying behavior over time.

The INF variable have at least one significant estimate in fifteen industries 05, 16, 17, 07, 03, 04, 01, 09, 08, 12, 19, 14, 15, 10, and 13, where the last three are significant at 10% significance level. Out of these fifteen industries ten are positively significant coded 05, 07, 03, 10, 13, 01, 08, 12, 19 and 14 have, suggesting that when rate of inflation increase Pakistan imports more of these commodities. The other three industries 15, 17, and 09 carries significant negative coefficients, signifying that inflationary economy discourage these industries to import. The remaining two industries 16 (Machinery and Mechanical Appliances with 16% market share) and 04 (Prepared Foodstuffs; Beverages, Spirits, Vinegar and Tobacco with 1.1% market share) attached to short-term mix positive and negative significant coefficients, does not providing the exact direction of rise or fall in imports of these commodities as a result of high inflation.

As for the effect of Pakistan economic activity, the results of short term industry-level import based model reveal that it carries significant estimates in seven industries coded 05, 16, 11, 07, 13, 01, and 08, in which 16 and 07 industries estimates are significant at 90% significance level. Thus, it shows that a growing Pakistani economy encouraging these industries to import more to the country, which included three large industries 05 (Mineral Products with 25% market share), 16 (Machinery and Mechanical Appliances with 16% market share), and 11 (Textiles and Textile Articles with 8% market share). There also three industries coded 02, 17, and 19 where industrial production carries at least one short term significant and negative coefficient. These must be industries for which the Pakistan import demand declines as its economy grows.

At the end ECM_{t-1} is reported as an alternative testing to long-term cointegration. The ECM_{t-1} replaces the level lag variables in equation. The significant negative coefficient supporting long-term cointegration, further as suggested by Pesaran et al. (2001) the t-ratio is applied. The results in all sectors are significantly greater than the upper limit critical value supporting the long-term cointegration except that of two sectors 11 and 08 that results fall within upper and lower bound critical values leading to the inconclusiveness of whether cointegration exist or not.

4.4 Non-Linear Relationship Between Exchange Rate and Trade Flows: An Application of NARDL Approach

In this second part the concentration is on nonlinear models. The nonlinear models are used to capture the asymmetric effects of exchange rate volatility by following the methodology of Shin et al. (2014). For the sake of asymmetric effect, the volatility variable is broke in PCH, positive changes in exchange rate volatility, and NCH, negative changes in exchange rate volatility. When the sign and size of linear demand model different from that of nonlinear model suggest asymmetric effect. As objective of this study is to consider the symmetric and asymmetric

effect of the only variable of interest exchange rate volatility, therefore the main focus in this discussion will be throughout on the exchange rate volatility.

In the first part the asymmetric effect of exchange rate volatility on Pakistan trade flow will is tested. Second, the basic, short and long-run asymmetric effect of uncertainty on exports with battery of diagnostic statistics. Third, the asymmetric effect of volatility on Pakistan imports. Fourth, the short and long-run supported with appropriated diagnostics statistics effect of exchange rate uncertainty on 20 Pakistan exporting industries identified by State bank of Pakistan (SBP) on commodity basis. Finally, the nonlinear effect of exchange rate volatility on 20 importing industries.

4.4.1 Non-Linear Relationship Between Exchange Rate and Aggregate Trade

4.4.1.1 Nonlinear Basic Aggregate Trade Model

The basic estimates of nonlinear aggregate trade model are reported in Table 4.20. The volatility measure is now break between positive changes, ΔPCH, and negative changes, ΔNCH. The coefficient attached to ΔPCH is insignificant while that of ΔNCH is significant at 10% significance level. The volatility in the linear model is also significant at 10% significance level. The inflation carries significant coefficient, implying that in case of higher inflation Pakistan trade less with the World. The inflation is significant in the linear model too. Further, the industrial production have significant coefficient, suggesting as expected the effect of economic activity on Pakistan trade flow. In short, the results does not show clear asymmetric effect of exchange rate volatility on Pakistan aggregate trade flow.

The F-statistic carries highly significant estimate, supporting the alternative hypothesis of cointegration. The Adj.R^2 is reported at the end of the table implying that 98% of the variation in aggregate trade demand is explained by the given number of independent variables.

4.4.1.2 Diagnostic Tests for Nonlinear Aggregate Trade Model

Table 4.21 begins with bound test that carries significant coefficient suggesting model stability. Secondly, the data is normally distributed as indicated by the insignificant value of Jarque-Bera. Thirdly, the model suffer from auto correlation because the LM estimate is significant. Fourthly, the RESET test insignificant value indicate that the optimum model is well specified. Finally, cumulative sum (CUM) and cumulative sum of square (CUMQ) are reported that show model stability indicated by S.

4.4.1.3 Long-Run Nonlinear Relationship Between Exchange Rate and Aggregate Trade

The long-term coefficient estimates of NARDL aggregate trade model are presented in Table 4.22. The coefficient attached to ΔNCH is significant while that of ΔPCH is insignificant, implying that decreasing volatility effect Pakistan aggregate trade and increasing volatility does not affect trade demand. The coefficient of Volatility in the linear aggregate trade model is insignificant at 5% significance level. It is on the safe side to say that there is asymmetric effect of exchange rate volatility on Pakistan aggregate trade flow. The result of the Wald-L reported in Table 4.20. The Wald-L test is applied on the long-term normalized coefficients of the ΔPCH and ΔNCH. The significant coefficient of Wald-L support impact asymmetric in the long-run, implying that aggregate trade flow respond differently when volatility in the value of PKR increase as compared to when volatility decreases. Furthermore, growing foreign direct investment in Pakistan adversely affect the aggregate trade demand indicated by the significant negative coefficient of FDI. In case of higher interest rate in the country Pakistan trade more with rest of the world represented by the positive significant coefficient attached to LnIR. As expected industrial production (IP) effect aggregate trade flow positively indicated by the positive significant coefficient.

4.4.1.4 Short-Term Nonlinear Relationship Between Exchange Rate and Aggregate Trade

The short-run nonlinear aggregate trade based model coefficients are presented in Table 4.23. Looking at the table, increased volatility, ΔPCH, carries one significant coefficient while in the linear aggregate trade model the coefficient is insignificant at 95% confidence level, thus, supporting asymmetric effect of exchange rate volatility on Pakistan aggregate trade flow. Therefore, when separating increase volatility of exchange rate from decrease volatility yields short-run significant effect this should be attributed to the nonlinear adjustment to the volatility measure in the aggregate trade model. Second, short-run adjustment asymmetry is observed since ΔPCH follows different lag order than ΔNCH. Third, short-term asymmetric effect is observed of volatility on aggregate trade demand because either size or sign attached to each lag is different. Finally, cumulative asymmetry or impact asymmetric is establish, since the Wald-S test reported in Table 4.20 carries significant coefficient.

The coefficient of NEX, when the nonlinear adjustment made to the exchange rate volatility, becomes significant indicating the effect of exchange rate on Pakistan aggregate trade. Moreover, FDI also effect the aggregate trade as indicated by the significant estimates, the estimate is insignificant in linear aggregate trade model (1). Furthermore, the coefficients attached to interest rate, remittances, and industrial production are also significant, showing the effect on trade.

The highly significant estimate of error correction model further supported by t-ratio greater value than the Pesaran et al. (2001) upper bound critical value, validating the existence of long-term cointegration in the aggregate trade model.

TABLE 4.20: Coefficient Estimates of Non-Linear Aggregate Trade Model

Particulars (Trade Share)	Coefficient Estimates										
	Constant	PCH_t	NCH_t	$LnNEX_t$	$LnFDI_t$	$LnIR_t$	$LnRT_t$	LnINF	LnIP	F-stat.	Adj. R^2
Ln Trade Flows (1.00)	29.236	-0.014	0.029*	0.751	-0.025	0.058	0.049	2.874**	0.299**	85.33**	0.982
Ln Exports (0.27)	-17.97*	0.018**	-0.022	0.559*	0.025	0.470*	0.388*	0.27	0.552**	240.0**	0.995
Ln Imports (0.73)	20.18*	-0.031**	0.007	0.411	-0.012	0.447	0.17	4.105**	0.472**	67.76**	0.978

*A. **indicate significance level at 5%, respectively. *indicate significance level at 10%, respectively. B. PCH=Positive changes in Exchange rate volatility, NCH=Negative changes in volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. C. at the 5% (1%) significance level when the number of explanatory variables are seven (K=7) the F-Statistics Lower bound critical values are 2.32 (2.96) and upper bounds critical values are 3.50 (4.26). These bound critical values are taken from Pesaran et al. (2001) Table CI Case III, Page number 36.*

TABLE 4.21: Diagnostic Statistics Associated with Table 4.20 (Nonlinear Aggregate Trade Model)

Particulars (Trade Share)	Diagnostic Statistics							
	Bound	Wald-S	Wald-L	Jarque-Bera	LM	RESET	CUM	CUMQ
Ln Trade Flows (1.00)	4.074**	4.53**	18.67**	0.613	2.78	0.0048	S	S
Ln Exports (0.27)	27.18**	6.43**	15.35**	1.091**	1.3	0.778	S	U
Ln Imports (0.73)	5.63**	5.70**	13.15**	1.38	2.73	0.011	S	S

*A. **indicate significance level at 5%. *indicate significance level at 10%. B. Trade share is the percentage Proportionate Share of each industry in the total trade over the sample period. C. Bound is the is the model stability test. Jarque-Bera is the goodness-of-fit test for the sample normality. LM is the residual serial correlation test stands for Lagrange Multiplier and with one degree of freedom is distributed as X^2. REST is the Ramseys reset test for the model misspecification it is also denoted by X^2 with one degree of freedom. CU and CUQ shows Cumulative sum and cumulative sum square tests for the stability of the Model and indicated by S for stable.*

TABLE 4.22: Long-Run Coefficient Estimates of Nonlinear Aggregate Trade Model

Particulars (Trade Share)	**Long-run Coefficient Estimates**								
	Constant	**PCH**$_t$	**NCH**$_t$	**LnNEX**$_t$	**LnFDI**$_t$	**LnIR**$_t$	**LnRT**$_t$	**LnINF**$_t$	**LnIP**$_t$
Ln Trade Flows (1.00)	14.38**	0.00	0.027**	0.005	-0.05**	0.133**	-0.308	0.908*	0.147**
Ln Exports (0.27)	-14.993	-0.038	0.080**	0.003	0.234**	0.005	1.443*	1.129	0.065**
Ln Imports (0.73)	11.63**	-0.018*	0.020*	0.114	-0.03	-0.001	-0.179	0.822	0.203**

*A. **indicate significance level at 5%, respectively. *indicate significance level at 10%, respectively. B. PCH=Positive changes in Exchange rate volatility, NCH=Negative changes in Volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. C. Trade share is the percentage proportionate share of each industry in the total trade over the sample period.*

TABLE 4.23: Short-Run Coefficient Estimates of Nonlinear Aggregate Trade Model

Particular	Short-run Coefficient Estimates									
	$\mathbf{LnDV}_{t-1}$	$\mathbf{LnDV}_{t-2}$	$\Delta\mathbf{PCH}_t$	$\Delta\mathbf{PCH}_{t-1}$	$\Delta\mathbf{PCH}_{t-2}$	$\Delta\mathbf{PCH}_{t-3}$	$\Delta\mathbf{NCH}_t$	$\Delta\mathbf{NCH}_{t-1}$	$\Delta\mathbf{NCH}_{t-2}$	$\Delta\mathbf{NCH}_{t-3}$
Ln Trade Flows (1.00)	1.042**	0.534**	-0.014	0.020**			0.029*	-0.031*	-0.017	-0.012
Ln Exports (0.27)	0.101	-0.241	0.018**	0.007	0.006	0.032*	-0.022	-0.028**	-0.016	-0.075**
Ln Imports (0.73)	0.64*	0.306	-0.03**	0.037**			0.007	-0.05**	-0.031	

Particular	Short-Run Coefficient Estimates									
	$\mathbf{LnNEX}_t$	$\mathbf{LnNEX}_{t-1}$	$\mathbf{LnNEX}_{t-2}$	$\mathbf{LnFDI}_t$	$\mathbf{LnFDI}_{t-1}$	$\mathbf{LnFDI}_{t-2}$	$\mathbf{LnIR}_t$	$\mathbf{LnIR}_{t-1}$	$\mathbf{LnIR}_{t-2}$	$\mathbf{LnRT}_t$
Ln Trade Flows (1.00)	0.751	1.688**	-1.187**	-0.025			0.058	2.19**	-2.35**	0.049
Ln Exports (0.27)	0.559*	0.202	0.389	0.025	-0.047**	-0.07**	0.47*	1.31**	-2.14**	0.388*
Ln Imports (0.73)	0.411	2.228**	-1.618**	-0.012			0.447	1.241	-1.53**	0.17

Particular	Short-Run Coefficient Estimates								
	$\mathbf{LnRT}_{t-1}$	$\mathbf{LnRT}_{t-2}$	$\mathbf{LnINF}_t$	$\mathbf{LnINF}_{t-1}$	$\mathbf{LnINF}_{t-2}$	$\mathbf{LnIP}_t$	$\mathbf{LnIP}_{t-1}$	$\mathbf{LnIP}_{t-2}$	$\mathbf{ECM}_{t-1}$
Ln Trade Flows (1.00)	-0.094	0.126	2.87**	-2.045*	-1.404	0.30**			-2.03**(-6.38)
Ln Exports (0.27)	-0.49**	-0.45**	0.27	-0.968	-0.572	0.55**	0.432**	0.35**	-1.20**(-4.65)
Ln Imports (0.73)	-0.10	0.017	4.11**	-1.31	-0.576	0.47**	0.121	0.074	-1.735(-4.18)

*A. **indicate significance level at 5%, respectively. *indicate significance level at 10%, respectively. D. The t-ratio values are given in the parentheses next to ECM_{t-1}. The t-ratio upper bound critical values at 5% (1%) significance level when number of exogenous variables seven (k=7) are -4.57 (-5.19) and lower bounds are -2.86(-3.43). These values are taken from the Pesaran et al. (2001) Table C 02, case III, and page number 38.*

4.4.2 Nonlinear Relationship Between Exchange Rate and Export

4.4.2.1 Basic Nonlinear Export Based Model

In Table 4.20 the basic nonlinear coefficient estimates of export model are reported. The effect of increased uncertainty seem to be different than decrease uncertainty on Pakistan exports, since the coefficient attached to ΔPCH is significant and coefficient attached to ΔNCH is insignificant. The volatility estimate is also significant in the linear export based model.

The growing nominal exchange rate, interest rate and foreign remittances have significant positive effect on the exports of Pakistan at 10% significance level. As for the higher economic activity in the country Pakistan expands the volume of exports, indicated by as expected positive significant coefficient attached to LnIP.

To validate the long-run cointegration F-statistic test is performed. The estimate of F-statistic is significant and exceeds the upper bound critical value supporting long-run cointegration. Further, the goodness-of-fit test Adj.R^2 is performed to know the variation in dependent variable explained by the total independent variables included in the export demand equation.

4.4.2.2 Diagnostic Tests for Nonlinear Export Based Model

A battery of diagnostic statistics associated to export model are reported in Table 4.21. The bound test carries highly significant coefficient indicating that model is within the critical bounds and stable. Secondly, the measure of normality of data Jarque-Bera estimates is significant, implying data do not normally distributed. As in the case of long term cointegration the data may not be normal. Thirdly, the insignificant LM statistic show optimum model do not suffer from autocorrelation. Fourthly, Ramseys RESET test estimate is insignificant demonstrating that optimum model is well specified. Lastly, CUM show model stability but once square the cumulative sum model become unstable indicated by U. Therefore, dummy variable is used that resulted in export model stability.

4.4.2.3 Long-Term Nonlinear Relationship Between Exchange Rate and Export

In Table 4.22, the coefficients of nonlinear export based model are reported. Looking at the table, volatility measure carries insignificant coefficient attached to ΔPCH and significant positive coefficient attached to ΔNCH, implying long-run asymmetric effect of exchange rate volatility on Pakistan exports. Further, either size or sign of coefficient associated to ΔPCH is different from the one associated to ΔNCH indicating long-run asymmetric effect.

To answer the question that how significant are these differences of increased volatility from decreased volatility. The Wald-L test is applied on the equality of normalized long-term estimates of both ΔPCH and ΔNCH variables. The Wald-L statistic is significant indicating long-run cumulative effect asymmetry. The higher foreign direct investment in Pakistan encourage exports, supported by the significant positive estimate of FDI. Likewise a growing economic activity also improves Pakistan exports, suggested by the positive significant estimate attached to industrial production.

4.4.2.4 Short-Term Nonlinear Relationship Between Exchange Rate and Export

The short-run coefficients of nonlinear exports based model are reported in Table 4.23. Where both positive changes in volatility, ΔPCH, and negative changes in volatility, ΔNCH, carries significant coefficients, implying that both increasing and decreasing volatility affect Pakistan short-term export demand. Additionally, asymmetric effect of volatility is observed since either size or sign of the estimated coefficient is different. Finally, short-run cumulative adjustment asymmetry is noted supported by the significant coefficient of Wald-S.

Further foreign direct investment carries significant lag level coefficients, demonstrating short-run effect of FDI on exports volume. This significant coefficients resulted after the introduction of nonlinear adjustments to the volatility measure

because the FDI coefficient is insignificant in linear export based model. Moreover, interest rate have significant lag level coefficients suggesting the effect on exports. The growing flow of remittances into Pakistan encourage Pakistan exports supported by significant and lagged level coefficients attached to RT. A rising economic activity have a significant positive short-term effect on Pakistan exports because all the coefficients of industrial production are significant.

The error correction model additionally support the alternative hypothesis of long-run cointegration in nonlinear export based model because the ECM_{t-1} estimate significant and negative. Further the t-ratio estimate is greater than the upper bound critical value of Pesaran et al. (2001).

4.4.3 Nonlinear Relationship Between Exchange Rate and Import

4.4.3.1 Basic Nonlinear Import Based Model

There is significant coefficient attached to ΔPCH and the coefficient attached to ΔNCH is insignificant, implying that increased volatility effect Pakistan imports volume while decreased volatility does not effect. The volatility estimate is insignificant in the linear import based model. Thus, once the increased volatility is separated from decreased volatility the affect of volatility on Pakistan import is significant.

Furthermore, same like the linear model, in the nonlinear import model the coefficient estimates of inflation and industrial production are significant, suggesting the effect on Pakistan imports.

The estimate of F-statistic is highly significant and exceeds the upper bound critical value of 3.50 supporting the long-run cointegration. The coefficient of Adj.R^2 indicate that out of total variation in import demand model 97.8% is explained by the given number of explanatory variables.

4.4.3.2 Diagnostic Tests for Nonlinear Import Model

The diagnostic statistics of NARDL import based model are reported in Table 4.21. Firstly, the value of bound test is significant and greater than the upper bound value suggesting model stability. Secondly, the estimate of Jarque-Bera is insignificant demonstrating data is normally distributed. Thirdly, the data is free from serial correlation as the coefficient of LM test is insignificant. Lastly, the optimum models are stable, checked by both CUM and CUMQ test and indicated by S.

4.4.3.3 Long-Term Nonlinear Relationship Between Exchange Rate and Import

The long-run coefficient estimates of NARDL import based model are reported in Table 4.22. The coefficient of ΔPCH is negatively significant and ΔDeNCH is positively significant at 10% significance level, demonstrating that increased volatility discourage and decreased volatility encourage Pakistan import demand. The significant estimate of Wald-L suggest impact asymmetric or cumulative adjustment asymmetric of the exchange rate volatility on Pakistan imports, since the sum of the long-run coefficient attached to ΔPCH is different from the sum attached to ΔNCH. All other coefficients are insignificant except that of industrial production indicating that a growing economic activity in the country improve imports.

4.4.3.4 Short-Run Nonlinear Relationship Between Exchange Rate and Import

In Table 4.23, first there are significant coefficients attached to both Positive changes in volatility, ΔPCH, and negative changes in volatility, ΔNCH, supporting the short run asymmetric effect of exchange rate uncertainty on Pakistan imports. Secondly, short-run adjustment asymmetry is observed, since the lags order followed by ΔPCH is different from ΔNCH. Finally, Wald-S is applied to establish short-term impact asymmetry. The reported estimate of Wald-S in 20 is significant supporting short-run impact asymmetry.

Now other explanatory variables are discussed in the subsequent paragraph. The short run effect of nominal exchange rate is also significant supporting by it significant lagged and level coefficients. The coefficients attached to interest rate, inflation and industrial production significant supporting the effect on Pakistan imports volume.

An alternative to the F-statistic for long-run cointegration ECM_{t-1} is performed by changing the specification in the import demand model. The ECM_{t-1} carries as required significant and negative coefficient supporting long-term cointegration.

TABLE 4.24: Coefficient Estimates of Basic Nonlinear Industry-Level Export Model

Industry (Trade Share)	**Coefficient Estimates**										
	Constant	**PCH_t**	**NCH_t**	**$LnNEX_t$**	**$LnFDI_t$**	**$LnIR_t$**	**$LnRT_t$**	**$LnINF_t$**	**$LnIP_t$**	**F-stat.**	**Adj. R^2**
11-Textiles (0.59)	5.68**	0.018**	0.054**	0.66**	-0.008	-0.263	0.08	-0.118	0.18**	86.8**	0.982
02-Vegetable (0.11)	44.84**	-0.065*	0.129*	1.789	0.02	-0.657	-0.519	1.186	-0.41	15.4**	0.913
05-Minerals (0.05)	-2.36	0.02	0.022	-0.507	0.09	0.418	-0.107	7.540**	0.401*	43.1**	0.966
04-Foodstuff (0.052)	36.85	0.024	0.062	-2.494	-0.307	0.55	-1.8**	12.06**	0.14	20.4**	0.935
08-Skins and Leather (0.0471)	26.94**	0.047**	0.035**	0.225	-0.064**	-0.798	0.002	4.33**	0.238**	19.3**	0.909
01-Live Animals (0.034)	8.49*	0.015	0.037**	-0.509	0.046	-0.084	0.139	1.167	0.132	106.7**	0.977
06-Chemicals (0.027)	-52.84**	0.006	-0.045	-1.95*	0.271**	1.537*	0.751*	-5.54**	0.142	11.6**	0.866
15-Metals (0.023)	-30.84**	-0.060*	0.008	-0.845	-0.061	0.35	0.085	-0.381	-0.255	34.8**	0.958
07-Plastics (0.020)	-37.9**	-0.12**	0.008	-0.481	0.169*	1.396	1.38**	-1.152	-0.265	17.4**	0.92
18-Optical and Photographic (0.018)	-10.67	0.025	-0.025	-0.623	-0.046	0.668	1.53**	4.28**	0.288*	39.7**	0.965
16-Machineries (0.0066)	52.46*	0.015	-0.179	4.54**	-0.32**	0.162	-0.23	-1.928	-0.83**	4.68**	0.727
12-Footwears & Umbrellas (0.0043)	-4.407	0.006	0.141**	-2.05**	0.044	0.415	0.775**	7.67**	0.081	9.66**	0.859
10-Pulps of Wood (0.0038)	56.95**	-0.21**	0.152	-3.15	-0.28**	0.647	1.298	-7.798	0.328	10.7**	0.864
17-Vehicles (0.0031)	-100.6**	0.004	-0.065	-0.541	0.242**	-0.735	-0.411	5.295	0.755**	9.35**	0.84
03-Oils and Waxes (0.0022)	-16.31	0.100*	-0.148	1.253	0.06	-1.671	1.85**	4.354	-0.60*	12.52**	0.885
13-Stones and Cement (0.00183)	26.02*	0.021	0.153*	-0.904	-0.153	0.588	0.507	5.569	0.1	8.60**	0.825

Table 4.24 (Continued)

Industry (Trade Share)	Coefficient Estimates										
	Constant	PCH_t	NCH_t	$LnNEX_t$	LnFDI	$LnIR_t$	$LnRT_t$	$LnINF_t$	$LnIP_t$	F-stat.	Adj. R^2
09-Woods (0.0018)	-72.18**	0.101**	-0.067	3.51*	0.285**	-3.6**	-0.225	-5.88	0.541	21.2**	0.929
19-Arms and Ammunition (0.0008)	39.3	0.222*	0.323	-2.003	-0.44	-1.119	-0.75	-1.348	0.323	5.47**	0.734
14-Precious Stones (0.00065)	23.84	-0.329**	0.343*	-13.6*	0.33	-4.925	0.088	26.61*	-0.91	7.62**	0.819
20-Arts and Antiques (0.00048)	221.4*	-0.08	-0.175	-5.46	-1.109*	6.404	-2.362	47.64**	-0.433	3.04**	0.59

*A. **indicate significance level at 5%, respectively. *indicate significance level at 10%, respectively. B. PCH=Positive changes in Exchange rate volatility, NCH=Negative changes in Exchange rate volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. C. at the 5% (1%) significance level when the number of explanatory variables are seven (K=7) the F-Statistics Lower bound critical values are 2.32 (2.96) and upper bounds critical values are 3.50 (4.26). These bound critical values are taken from Pesaran et al. (2001) Table CI Case III, Page number 36. D. 11—Textiles and Textile Articles (0.5905), 02—Vegetable Products (0.1102), 05—Mineral Products (0.0534), 04—Prepared Foodstuffs; Beverages, Spirits, Vinegar and Tobacco (0.0516), 08—Raw Hide and Skins, Leather, Fur skins and Articles thereof (0.04708), 01—Live Animals and Animals Products (0.03375), 06—Products of Chemical or Allied Industries (0.02727), 15—Base Metals and Articles or Base Metal (0.02226), 07—Plastics and Articles thereof; Rubber and Articles thereof (0.01985), 18—Optical, Photographic, Cinematographer, Measuring, Precision Apparatus (0.01831), 16—Machinery and Mechanical Appliances (0.00665), 12—Footwear, Headgear, Umbrellas, Walking Sticks etc. (0.00430), 10—Pulp of Wood or of other Fibrous Cellulosic Material (0.00379), 17—Vehicles, Aircraft, Vessels and Associated Transport Equipment (0.00306), 03—Animal or Vegetable Fats, Oils and Waxes (0.00213), 13—Articles of Stone, Plaster, Cement, Asbestos, Mica or similar Materials (0.00183), 09—Wood and Articles of Wood (0.00180), 19—Arms and Ammunition, Parts and Accessories thereof (0.00083), 14—Natural or Cultured Pearls, Precious or Semi-Precious Stones, Metals (0.00065), 20—Works of Arts, Collectors, Pieces, Antiques and Special Transactions NES (0.000477)*

4.4.4 Nonlinear Relationship Between Exchange Rate and Industry-Level Export

The nonlinear industry-level export based model basic estimates are reported in Table 4.24.

4.4.4.1 Basic Nonlinear Industry-Level Export Model

Now the discussion is turned toward the main contribution of this paper, asymmetric effect of exchange rate volatility. The PCH, positive changes in exchange rate volatility and NCH, negative changes in exchanger rate volatility are created. The ΔPCH and ΔNCH either of them carries significant coefficients in eight industries coded 11, 08, 07, 10, 09, 14, 01, and 12. From the list industry 11 (Textiles and Textile Articles) is the largest exporting industry of Pakistan with 59% market share, whose exports are increased whether the volatility is resulted from Positive changes are negative changes in exchange rate. Three industries coded 07, 10, and 14 exports are adversely effected by exchange rate volatility and five industries coded 11, 08, 09, 01, and 12 exports positively respond to volatility. The number of significant coefficients are ten in linear export based model. The four industries coded 18, 16, 13, and 20 are significant in linear export based models but insignificant in nonlinear models. On the other hand, two industries coded 09 and 01 are significant in nonlinear export based model but are insignificant in the linear models. Further the size and sign of all the coefficients are different in the nonlinear models from the linear models, thus, there exist asymmetric effect of exchange rate volatility. When extending the discussion to 90% confidence level further six industries coded 02, 15, 03, 19, 13, and 14 industries carries significant coefficients that attached to either ΔPCH or ΔNCH. Industry 02 (Vegetable Products) a largest industry with 11% market share in the list whose exports are adversely effected by the ΔPCH and positively affected by ΔNCH.

The variable nominal exchange rate (NEX) carries three significant coefficients in industries coded 11, 16, and 12 of which industry 12 (Footwear, Headgear, Umbrellas, Walking Sticks etc.) exports are adversely effected by exchange rate

and remaining two exports are positively responding to exchange rate. There is only one significant coefficient of NEX in the basic linear export based model. So it is on the safe side to express that after the nonlinear adjustment for the volatility measure the exchange rate predictions are more clear and confident. As for the foreign direct investment in Pakistan three industries coded 06, 17, and 09 coefficients are positively significant and three industries coded 08, 16, and 10 coefficients are negatively significant totalling six significant coefficients. The number of significant coefficients are three in the linear export based model in industries coded 15, 18, and 10.

The next explanatory variable interest rate carries just one significant coefficient in industry 9 (Wood and Articles of Wood) and the other coefficient is significant at 10% confidence level in industry 06 (Products of Chemical or Allied Industries). There are five significant coefficients attached to IR in linear export based model. The remittances to the country significantly affected the exports of five industries coded 04, 07, 18, 12, and 03. The three industries coded 11, 18, and 10 coefficients are significant in linear export based model. The rate of inflation carries seven significant coefficients in industries coded 05, 04, 08, 06, 18, 12, and 20 of which just one industry 08 (Raw Hide and Skins, Leather, Fur skins and Articles thereof) exports are adversely effected by the change in inflation. The number of significant coefficients attached to INF are ten in basic linear export based model. Finally, industrial production (IP) carries four significant coefficients in industries coded 11, 08, 16, and 17. The significant coefficients are five in linear export based model. At 90% confidence level further three industries coded 05, 18, and 03 coefficients becomes significant.

In short, three explanatory variables nominal exchange rate (NEX), foreign direct investment (FDI), and Remittances (RT) coefficients are increased after nonlinear adjustment for volatility measure in export based model. On the other hand three explanatory variables interest rate (IR), inflation rate (INF), and industrial production (IP) significant coefficients decreased after linear adjustments in export based model for volatility measure. But in total the number of significant

coefficients for all the explanatory variables are greater in nonlinear export based model than that of linear export based model.

Furthermore, the long-term cointegration in all industries is valid, since the F-statistic value is highly significant except in a smallest industry 20 (Works of Arts, Collectors, Pieces, Antiques and Special Transactions NES) where the estimate is in between the upper and lower limit critical values leading to the inconclusiveness. At the end, the measure of goodness-of-fit adjusted Adj. R^2 is reported indicating that maximum portion in all the exporting industries is explained by the included explanatory variables.

TABLE 4.25: Diagnostic Statistics Associated with Table 4.24 (Nonlinear Industry-Level Export Model)

Industry (Trade Share)	Diagnostic statistics							
	Bound	**Wald-S**	**Wald-L**	**Jarque-Bera**	**LM**	**RESET**	**CUM**	**CUMQ**
11-Textiles (0.59)	6.89**	7.47**	30.34**	0.642	1.827	0.034	S	U
02-Vegetable (0.11)	4.69**	3.18**	0.106	4.20**	3.14	0.2616	S	S
05-Minerals (0.05)	13.59**	8.37**	6.51**	1.164	1.767	0	S	S
04-Foodstuff (0.052)	4.93**	5.41**	1.29	0.304	5.58**	0.046	S	S
08-Skins and Leather (0.0471)	4.60**	6.82**	0.027	0.593	1.652	3.587	S	S
01-Live Animals (0.034)	6.92**	1.12	1.91	0.968	1.82	2.767	S	S
06-Chemicals (0.027)	6.33**	3.67**	16.63**	8.15**	2.59	0.000	S	S
15-Metals (0.023)	7.303**	9.16**	7.94**	1.262	3.22	0.001	S	S
07-Plastics (0.020)	7.91**	5.70**	14.49**	0.2865	2.86	7.97**	S	S
18-Optical and Photographic (0.018)	3.303*	3.52**	5.73**	0.5703	3.26	0.001	S	S
16-Machineries (0.0066)	4.67**	6.56**	15.67**	0.571	2.89	0.211	S	S
12-Footwears & Umbrellas (0.0043)	13.47**	5.98**	12.0**	0.876	1.891	1.515	S	S
10-Pulps of Wood (0.0038)	6.79**	5.40**	2.34	0.4418	4.48**	0.474	S	S
17-Vehicles (0.0031)	3.05	8.94**	112.18**	9.185**	2.766	14.4**	S	U
03-Oils and Waxes (0.0022)	4.23**	0.028	16.01**	1.473	1.734	4.55**	S	S
13-Stones and Cement (0.00183)	3.21*	2.69**	0.25	0.756	1.881	0.013	S	S
09-Woods (0.0018)	3.12	2.58	8.87**	0.7982	6.92	6.92**	S	S
19-Arms and Ammunition (0.0008)	9.65**	3.06**	4.60**	1.493	2.659	2.865	S	U
14-Precious Stones (0.00065)	2.78	3.61**	7.08**	1.481	2.174	17.80**	S	S
20-Arts and Antiques (0.00048)	5.16**	4.25**	13.88**	0.848	5.144**	0.177	S	S

*A. **indicate significance level at 5%. B. The Particulars of each industry is given in notes of Table 4.24. C. Bound is the Model Stability test. Jarque-Bera is the normality test. LM is the residual serial correlation test stands for Lagrange Multiplier and with one degree of freedom is distributed as X^2. REST is the Ramseys reset test for the model misspecification it is also denoted by X^2 with one degree of freedom. CU and CUQ shows Cumulative sum and cumulative sum square tests for the stability of the Model and indicated by S for stable and U for unstable at 5% significance level.*

4.4.4.2 Diagnostic Tests for Nonlinear Industry-Level Export Model

The diagnostic statistics associated with nonlinear export based model are reported in Table 4.25. For stability of all optimum models bound test, Cumulative sum, and Cumulative sum of square are used and for normality of the data Jarque-Bera test is used. To detect serial correlation and model specification the Lagrange Multiplier (LM) and Ramseys RESET test are used respectively. The bound test applied on all exporting industries indicate all optimum models are stable except of four relatively small industries coded 17, 13, 09, and 14. Secondly, most of the optimum models carries insignificant Jarque-Bera coefficients indicating that data is normally distributed. Thirdly, all the optimum models are free from serial correlation since the result of LM test is insignificant in all models except in industries coded 04, 03, and 20. Fourthly, most of the models are correctly specified since the RESET statistic is insignificant in most of the optimum models. Finally, most of the nonlinear short-term and long-term coefficient estimates do not suffer from the models instability since the CUM and CUMQ tests support stability indicated by S. But there are three cases where as for the CUMQ the optimum models are unstable. So, the dummy variable is used in the equation to bring model stability.

TABLE 4.26: Long-Run Coefficient Estimates of Nonlinear Industry-Level Export Model

Industry (Trade Share)	**Long-Run Coefficient Estimates**								
	Constant	**PCH$_t$**	**NCH$_t$**	**LnNEX$_t$**	**LnFDI$_t$**	**LnIR$_t$**	**LnRT$_t$**	**LnINF$_t$**	**LnIP$_t$**
11-Textiles (0.59)	6.078**	0.019**	0.069**	1.019**	-0.009	0.225**	0.312	-0.181	0.093**
02-Vegetable (0.11)	13.47**	0.053**	0.026	1.706	-0.112	0.834**	-0.093	-1.421	0.092
05-Minerals (0.05)	-1.3	0.067**	0.099**	-0.28	0.236**	1.377**	0.382	0.387	0.075**
04-Foodstuff (0.052)	31.3	0.00	0.101	-3.578	-0.256	-0.184	-4.165*	9.655	0.4
08-Skins and Leather (0.0471)	28.21**	0.049**	0.028	1.096	-0.42**	0.341**	-0.79**	-1.251	0.249**
01-Live Animals (0.034)	13.90*	-0.006	0.060*	-3.59**	0.075	-0.138	-2.78**	9.24**	-0.049
06-Chemicals (0.027)	-45.48*	-0.074**	0.161**	-3.80**	0.734**	-0.492	1.894	7.284**	-0.258*
15-Metals (0.023)	-82.04	-0.14	0.443	6.347	1.119	-0.743	0.226	9.818	0.005
07-Plastics (0.020)	-16.8**	-0.072**	0.022	-0.847	-0.056	0.025	1.560**	1.979*	-0.077
18-Photographic (0.018)	-6.53	-0.042	-0.023	2.025	-0.028	-0.242	1.942*	-3.403*	0.142*
16-Machineries (0.0066)	38.72*	-0.082	-0.234*	-3.384	-0.163	0.378	-1.994	2.986	-0.245
12-Footwears & Umbrellas (0.0043)	-4.538	0.050*	0.219**	6.79**	-0.188	-0.525*	0.722	-4.135*	0.448**
10-Pulps of Wood (0.0038)	36.57**	0.004	0	1.432	-0.57**	0.098	-2.523*	1.07	0.437**
17-Vehicles (0.0031)	-55.7**	-0.145**	0.266**	-3.414*	0.768**	-0.47**	0.267	12.25**	-0.017
03-Oils and Waxes (0.0022)	-7.824	-0.095**	0.044	-1.33*	-0.25**	0.369*	0.887**	2.555*	-0.01
13-Stones and Cement (0.00183)	13.61*	0.073**	0.061*	2.971	-0.26**	1.104**	0.224	-3.529	0.125
09-Woods (0.0018)	-88.1**	0.008	0.321**	-2.737	1.03	-0.297	4.939*	5.478	-0.476*
19-Arms and Ammunition (0.0008)	243.5	1.378	0.015	-138.18	0.798	-2.644	-13.987	107.86	-7.74
14-Precious Stones (0.00065)	15.99	-0.220**	0.131	2.235	-0.737*	1.057	-6.593*	15.33	0.155
20-Arts and Antiques (0.00048)	270.15	0.064	-1.171**	-48.57	0.285	0.922	-26.42	58.69	-3.133

*A.**indicate significance level at 5%. *indicate significance level at 10%. B. PCH=Positive changes volatility, NCH=Negative changes in volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. C. The complete description of each industry is provided in the notes of Table 4.24. D. at the 5% (1%) significance when seven explanatory variables (K=7) the F-Statistics Lower bound critical values are 2.32 (2.96) and upper bounds critical values are 3.50 (4.26). These critical values are from Pesaran et al. (2001) Table CI Case III, Page number 36.*

4.4.4.3 Long-Term Nonlinear Relationship Between Exchange Rate and Industry-Level Export

Long-run coefficient estimates of nonlinear export based model are reported in Table 4.26. Results indicate that there are now thirteen industries coded 11, 02, 05, 08, 6, 07, 17, 03, 13, 14, 12, 09, and 20 in which either positive changes in exchange rate volatility (ΔPCH) or negative changes in volatility (ΔNCH) or both carry a significant estimate, supporting the long-term effect of volatility on exports of these sectors. Out of these total thirteen significant coefficients seven industries coded 11, 02, 05, 08, 13, 12, and 09 carries positive coefficients and four industries coded 07, 03, 14, and 20 negative significant coefficients. While the two sectors 06 (Products of Chemical or Allied Industries with 3% market share) and 17 (Vehicles, Aircraft, Vessels and Associated Transport Equipment) that becomes significant after nonlinear adjustments in the volatility variable carries significant negative coefficient in ΔPCH and significant positive coefficient in ΔNCH, implying that positive changes in volatility have different effect from that of decreased volatility. The number of significant coefficients are eleven in the linear export based model. Thus, once the positive changes in exchange rate volatility are separated from the negative changes yields more significant long-term coefficients and this additional significant estimates should be attributed to the nonlinear adjustments in the exchange rate volatility. Furthermore, either the sign or size of increased volatility is different from that of decreased volatility in almost all industries, supporting the long run asymmetric effect of exchange rate volatility on Pakistan industry-level exports. For example, the sign of industry 06 (Products of Chemical or Allied Industries with 3% market share) is negatively significant in ΔPCH and positive significant in ΔNCH, suggesting that positively increased volatility improve the export of industry and negative changes adversely affect volatility of exchange rate. When the significance level is extended from 5% to 10% additionally four sectors coded 12, 01, 16, and 13 estimates attached to either ΔPCH or ΔNCH becomes significant. While there is only one sector significant at 10% significance level in linear export based model. Lastly long-term cumulative or impact asymmetric is observed in 14 industries, since the wald-L carries significant estimates.

Long-term effects of linear and nonlinear model have same results so need no further discussion Bahmani-Oskooee and Aftab (2017). But here the results are significantly different of the linear model from that of nonlinear model for all the variables in the export based model thus need further explanation. Looking at the nominal exchange rate it carries four significant coefficients in which half have negative and two positive estimates. The significant coefficients are five in the linear models. Thereafter, the FDI have seven significant coefficients in industries coded 05, 08, 06, 10, 17, 03, and 13. Of which three are positively significant in industries coded 05, 06, and 17, implying that Pakistan exports more of these products as a result of higher foreign direct investment in the country. The significant coefficients in linear models are six including industries coded 05, 08, 07, 16, 12, and 03. The three industries numbered 06, 10, and 17 are significant here in nonlinear model but are insignificant in linear model while the two significant coefficients in linear models are here insignificant.

Further there are just five industries coded 11, 02, 05, 08, and 13 where real interest rate have significant positive coefficients that are thirteen in linear export model. The other explanatory variable remittances carries two negative and two positive significant estimates. And additional five industries coded 04, 18, 10, 09, and 14 have significant coefficients at 90% confidence level. A rising inflation in the country encourage the exports of three sectors numbered 01, 06, and 17 indicated by significant positive estimates. Three industries becomes insignificant in nonlinear model. The growing economic activity in Pakistan boost up the export of the following industries indicated by significant positive coefficients attached to 11, 05, 08, 12 and 10. The other three sectors are significant at 90% confidence level.

TABLE 4.27: Short-Run Coefficient Estimates of Nonlinear Industry-Level Export Model

Industry (Trade Share)	**Short-run Coefficient Estimates**									
	$\mathbf{LnDV}_{t-1}$	$\mathbf{LnDV}_{t-2}$	$\mathbf{\Delta PCH}_{t}$	$\mathbf{\Delta PCH}_{t-1}$	$\mathbf{\Delta PCH}_{t-2}$	$\mathbf{\Delta PCH}_{t-3}$	$\mathbf{\Delta NCH}_{t}$	$\mathbf{\Delta NCH}_{t-1}$	$\mathbf{\Delta NCH}_{t-2}$	$\mathbf{\Delta NCH}_{t-3}$
11-Textiles (0.59)	0.107	-0.14	0.018**				0.054**	-0.004	0.019**	-0.015
02-Vegetable (0.11)	2.034**	1.323**	-0.065*	-0.062	0.025	-0.10**	0.129*	0.063	-0.118*	0.09
05-Minerals (0.05)	0.959**	0.730**	0.02	-0.045*	-0.03		0.022	0.014	-0.03	-0.120**
04-Foodstuff (0.052)	0.325	0.081	0.024	0.149*	-0.098	0.109	0.062	-0.142	-0.036	-0.14
08-Leather (0.0471)	0.237**		0.047**				0.035**	-0.033*	0.022	
01-Live Animals (0.034)	-0.58**	-0.553**	0.015				0.037**			
06-Chemicals (0.027)	-0.045	0.386**	0.006				-0.045	0.067	-0.067*	-0.139**
15-Metals (0.023)	-0.576*	-0.376	-0.06*	0.091**	0.110**	-0.17**	0.008	-0.024	-0.197**	0.063
07-Plastics (0.020)	1.457**	0.835**	-0.12**	-0.06	0.066*		0.008	0.113*	-0.156**	-0.100**
18-Photographic (0.018)	0.156	-0.55	0.025	-0.004	-0.027	0.083**	-0.025	-0.011	0.04	-0.097**
16-Machineries (0.0066)	0.012	-0.451	0.015	-0.003	0.143**	0.054	-0.179	0.072	-0.098	
12-Footwears (0.0043)	-0.68**	-0.744**	0.006	-0.07**	0.008	0.054*	0.141**	0.005	-0.104**	
10-Pulps of Wood (0.0038)	0.78**	1.51**	-0.22**	-0.0519	-0.0757		0.1515			
17-Vehicles (0.003)			0.004	0.005	0.134**		-0.065	0.109	-0.304**	-0.204**
03-Oils and Waxes (0.0022)	0.739**	0.666**	0.100*	-0.028	-0.029	0.155**	-0.148	-0.08	0.115	-0.142*
13-Stones and Cement (0.00183)	0.751**	0.792**	0.021	-0.043	-0.056		0.153*			
09-Woods (0.0018)	0.036	0.199	0.101**				-0.067	-0.003	0.032	-0.136*
19-Arms and Ammunition (0.00083)	-0.92**	-0.605**	0.222*				0.323	-0.062	0.968**	
14-Precious Stones (0.00065)	0.481	0.064	-0.33**				0.343*	0.31	-0.355	0.32
20-Arts & Antique (0.0048)	0.081	-0.139	-0.08	0.447**			-0.175	-0.613*	0.388	0.354

Table 4.27 (Continued)

Industry (Trade Share)	Short-run Coefficient Estimates									
	$\mathbf{LnNEX}_t$	$\mathbf{LNEX}_{t-1}$	$\mathbf{LNEX}_{t-2}$	$\mathbf{LnFDI}_t$	$\mathbf{LnFDI}_{t-1}$	$\mathbf{LnFDI}_{t-2}$	$\mathbf{LnIR}_t$	$\mathbf{LnIR}_{t-1}$	$\mathbf{LnIR}_{t-2}$	$\mathbf{LnRT}_t$
11-Textiles (0.59)	0.663**	-0.277	-0.247	-0.008			-0.263	1.224**	-1.53**	0.08
02-Vegetable (0.11)	1.789	4.583**	-0.738	0.02	0.168*		-0.657	1.952	-4.96**	-0.519
05-Minerals (0.05)	-0.507			0.09	0.013	-0.18**	0.418	3.203*	-3.83**	-0.107
04-Foodstuff (0.052)	-2.494	-3.718	9.890**	-0.307	-0.032	0.227	0.55	12.47**	-12.2**	-1.85**
08-Leather (0.0471)	0.225	-0.831	0.804	-0.06	0.045	0.081**	-0.798	1.708**	-1.45**	0.002
01-Live Animals (0.034)	-0.509	1.488		0.046			-0.084			0.139
06-Chemicals (0.027)	-1.95**	1.462		0.271**	-0.024	-0.14**	1.537*			0.751*
15-Metals (0.023)	-0.845	-1.88	4.266**	-0.061	-0.086	0.054	0.35	3.757	-2.214*	0.085
07-Plastics (0.020)	-0.481	2.065	2.027	0.169	0.177**		1.396	0.533	-0.912	1.383**
18-Photographic (0.018)	-0.623	-1.211		-0.046			0.668	-1.173	0.288	1.525**
16-Machineries (0.0066)	4.540**	0.66	0.39	-0.32	-0.074	-0.004	0.162	6.017*	-4.141	-0.229
12-Footwears (0.0043)	-2.05**	1.736	2.633*	0.044	0.267**		0.415	0.987		0.775**
10-Pulps of Wood (0.0038)	-3.148	2.1869	-3.97	-0.28	0.0961		0.64	3.06	4.07	1.29
17-Vehicles (0.003)	-0.541	-2.499	5.737*	0.242**	-0.196*	-0.41**	-0.735	0.464	-1.785	-0.411
03-Oils and Waxes (0.0022)	1.253			0.06	0.107	0.227**	-1.671	-3.778	3.588**	1.850**
13-Stones and Cement (0.00183)	-0.904	-1.182	0.265	-0.153	0.135	0.114	0.588	-1.483	-1.137	0.507
09-Woods (0.0018)	3.508*	0.723	-8.76**	0.285**	-0.37**	-0.20**	-3.62	4.098	-3.062	-0.225
19-Arms and Ammunition (0.00083)	-2.003	-13.456*	5.182	-0.44	-0.441		-1.119	-1.834	-16.53	-0.75
14-Precious Stones (0.00065)	-13.59*	17.944*	8.769	0.33	0.883**		-4.925	3.051	7.488	0.088
20-Arts and Antiques (0.00048)	-5.459	-1.855	34.733**	-1.11*	-0.126	0.271	6.404	-6.003	1.421	-2.362

Table 4.27 (Continued)

Industry (Trade Share)	Short-run Coefficient Estimates								
	$\mathbf{LnRT}_{t-1}$	$\mathbf{LnRT}_{t-2}$	$\mathbf{LnINF}_{t}$	$\mathbf{LnINF}_{t-1}$	$\mathbf{LnINF}_{t-2}$	$\mathbf{LnIP}_{t}$	$\mathbf{LnIP}_{t-1}$	$\mathbf{LnIP}_{t-2}$	$\mathbf{ECM}_{t-1}$
11-Textiles (0.59)	-0.152*	-0.140*	-0.118	-1.49**		0.185**	-0.016	0.140**	-0.94** (-5.77)
02-Vegetable (0.11)	-1.18**		1.186	-7.618	-5.79	-0.41	-0.193	-0.365	-3.33** (-3.89)
05-Minerals (0.05)	-0.322	-0.385	7.540**	-0.831	-4.57	0.401*	0.482**	-0.452**	-1.81** (-7.85)
04-Foodstuff (0.052)	1.092		12.06**	-8.091	-19.39**	0.14	0.557		-1.18** (-2.42)
08-Leather (0.0471)	0.178	-0.013	4.33**			0.238**			-0.95** (-7.88)
01-Live Animals (0.034)	0.51	0.455**	1.167	-7.88**		0.132			-0.61** (-3.46)
06-Chemicals (0.027)	0.108	-0.142	-5.54**	5.977*	-8.55**	0.142	0.660**		-1.162** (-4.32)
15-Metals (0.023)			-0.381	7.372	-15.15	-0.255			-0.376 (-1.11)
07-Plastics (0.020)	-0.395	-1.039**	-1.152	5.941	-14.53	-0.265	-0.091	0.469**	-2.25** (-6.65)
18-Photographic (0.018)	-0.93**	-0.361	4.283**	-1.713	7.370**	0.288	0.313*	-0.001	-1.64** (-2.47)
16-Machineries (0.0066)	0.713	1.115**	-1.928	-4.329		-0.83**	0.685	-0.37	-1.35** (-2.68)
12-Footwears (0.0043)	0.047	-0.768**	7.673**	2.71	-7.509**	0.081	0.035	-0.037	-0.97** (-5.23)
10-Pulps of Wood (0.0038)	2.24**	3.62**	-7.79	-12.16*	9.78*	0.32	0.019	-0.626	-1.56** (-6.06)
17-Vehicles (0.003)			5.295	10.268	-22.07	0.755*	1.037**	0.377	-1.80** (-15.2)
03-Oils and Waxes (0.0022)			4.354	1.11	12.67*	-0.602*	0.153	0.298	-2.08** (-7.06)
13-Stones and Cement (0.002)	0.234		5.569	-5.089	5.772	0.1			-1.91** (-4.68)
09-Woods (0.0018)	-1.312*	0.172	-5.888			0.541	0.545	-0.561	-0.82** (-2.30)
19-Arms, Ammunition (0.00083)			-1.348	19.546	19.351	0.323	-2.248	3.469**	-0.161 (-0.48)
14-Precious Stones (0.00065)	0.796	0.542	26.61*	15.035	-47.06	-0.91	2.704*	-2.094*	-1.49** (-4.09)
20-Arts and Antiques (0.00048)	0.991	5.957**	47.6**	-30.485	-12.58	-0.433			-0.82** (-3.19)

*A. **indicate significance level at 5%. *indicate significance level at 10%. B. PCH=Positive changes in volatility, NCH=Negative changes in Exchange rate volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. C.The complete description of each industry is provided in notes of Table 4.24. D. At the 5% (1%) significance level when explanatory variables are seven (K=7) the F-Statistics Lower bound critical values are 2.32 (2.96) and upper bounds are 3.50 (4.26).These critical values are taken from Pesaran et al. (2001) Table CI Case III, Page number 36.*

4.4.4.4 Short-Term Nonlinear Relationship Between Exchange Rate and Industry-Level Export

Now the results of short-term nonlinear export based model outlined by Eq. (7) are reported in Table 4.27. Looking at results, first either ΔPCH or ΔNCH carries at least one significant lagged level short term coefficient in eighteen industries coded 01, 02, 05, 08, 01, 06, 15, 07, 18, 16, 12, 10, 17, 03, 09, 02, 14, and 20, demonstrating volatility effect Pakistan exports. This number is twelve in linear model. Since the number of nonlinear estimates are significantly higher than the linear models, thus, this higher significant estimates are attributed to the nonlinear adjustments in volatility measure. Further at 90% confidence level all industries becomes significant, suggesting that exchange rate volatility affecting the exports of every industry. There are two industries 17 (Vehicles, Aircraft, Vessels and Associated Transport Equipment) and 18 (Optical, Photographic, Cinematographer, Precision Apparatus) where ΔPCH carries positive significant coefficient and ΔNCH significant negative coefficient, implying that the volume of exports increase when the volatility in exchange rate resulted from upward movement and decrease when the volatility resulted from downward movement. This is only possible when the nonlinear adjustment of the volatility measure performed. Second, short term asymmetric adjustment is observed in following fourteen industries coded 11, 05, 08, 06, 07, 16, 12, 10, 17, 13, 09, 19, 14, and 14, since the number of lags associated to ΔPCH are different from those of ΔNCH. Thirdly, short-rum asymmetric effect of volatility is observed in almost all sectors, since either the size or sign attached to ΔPCH is different from that of ΔNCH. Finally, the short run impact asymmetric is tested through Wald-S test and reported in Table 4.23. If sum of short term estimates associated to ΔPCH are different from sum associated to ΔNCH then there exist impact asymmetry. The impact asymmetric is observed in sixteen industries coded 11, 02, 05, 04, 08, 06, 15, 07, 18, 16, 12, 10, 17, 13, 19, and 20 out of total 20 industries, since the Wald-S statistic is significant in these sectors.

The remaining explanatory variables are explained shortly because the coefficients are different in the nonlinear models form linear export based model.

Exchange rate carries nine short term significant coefficients at either lags in industries coded 11, 02, 04, 06, 15, 16, 12, 09, and 20. The number of significant coefficients are seven in linear short term export based model. The improvement in the significant coefficients should be attributed to the nonlinear mechanism in the volatility measure. Foreign direct investment in Pakistan have eleven significant short term coefficients in following industries 05, 08, 06, 07, 16, 12, 10, 17, 03, 09, and 14. The significant coefficients in linear export based model are twelve. The interest rate attached to eight short-run significant estimates at either lag in industries coded 11, 02, 05, 04, 08, 03, 09, and 19, the significant estimates in the linear models are nine. The next variable remittances carries ten significant coefficients in industries coded 02, 04, 01, 07, 18, 16, 12, 10, 03, and 20. In the linear export based model the short term significant coefficients are eleven. A growing inflation rate in the country affect exports of twelve industries coded 11, 05, 04, 08, 01, 06, 07, 18, 12, 17, 14, and 20. The effect of inflation in linear models are on thirteen sectors. Furthermore, growing economic activity in Pakistan affects in the short run, exports of eight sectors coded 11, 05, 08, 06, 07, 16, 17, and 19. In case of linear export based model the effect of economic activity are on ten industries.

In short, the number of significant coefficients are more in nonlinear models for nominal exchange rate and lesser for the remaining variables in the model. But one thing is clear that after the nonlinear introduction in volatility measure the size, sign and significance level becomes different from the linear models.

Finally, the estimates of ECM_{t-1} and t-ratio in parentheses next to ECM_{t-1} estimates are reported in Table 4.25. The alternative hypothesis of long-run cointegration is supported in all sectors, except two coded 15 and 19 where the associated estimates are insignificant, since the coefficients of ECM_{t-1} are significant and negative. Further, t-ratio associated to ECM_{t-1} does not support the existence of long-term cointegration in six sectors coded 08, 15, 18, 16, 09, and 19, since the estimates are below the lower bound critical value -2.86, at 5% significance level, of Pesaran et al. (2001).

TABLE 4.28: Coefficient Estimates of Nonlinear Industry-Level Import Model

Industry (Trade Share)	**Coefficient Estimates**										
	Constant	**PCH_t**	**NCH_t**	**$LnNEX_t$**	**$LnFDI_t$**	**$LnIR_t$**	**$LnRT_t$**	**$LnINF_t$**	**$LnIP_t$**	**F-stat.**	**Adj. R^2**
5-Minerals (0.255)	30.60**	-0.011	0.067	0.709	-0.033	-0.313	0.128	11.00**	0.812**	29.88**	0.947
16-Machineries (0.16)	43.26**	-0.002	-0.09**	0.48	0.116**	0.999**	-0.178	-1.97*	0.261	54.66**	0.971
06-Chemicals (0.11)	-37.45**	-0.004	0.005	-0.9	0.015	0.577	0.752**	4.498**	0.268	25.82**	0.946
15-Metals (0.085)	57.55**	-0.027*	-0.18**	2.22**	0.056	1.850**	0.209	-2.194	0.305	34.59**	0.955
11-Textiles (0.075)	49.53**	-0.15**	0.033	-0.397	-0.154*	-1.635	-1.6**	1.299	0.629**	18.70**	0.905
2-Vegetables (0.06)	47.51**	-0.13**	0.003	-3.564	-0.081	2.44	-0.611	7.116*	-0.24	12.63**	0.894
17-Vehicles (0.06)	100.7**	0.047	0.039	4.58	-0.55**	1.82	0.783	3.473	0.075	14.31**	0.921
07-Plastics (0.052)	29.15**	-0.014	0.005	0.742	-0.10**	-0.058	-0.018	2.36**	0.328**	53.72**	0.965
03-Oils and Waxes (0.043)	-138.5**	0.022	-0.306*	0.687	-0.263*	4.509	1.35	-0.989	1.072*	27.27**	0.957
20-Arts and Antiques (0.038)	20.29	-0.136	0.390**	-6.82**	0.187	2.419	-1.756	16.82**	0.554	2.70**	0.468
10-Pulps of Wood (0.0158)	70.59**	0.045**	0.129**	-0.293	-0.21**	1.405	-1.09**	-0.636	0.232	39.55**	0.966
18-Optical and Photographic (0.02)	50.53**	0.033	0.071	1.668	0.076	-3.84**	-0.561	-0.037	0.071	19.44**	0.919
04-Foodstuffs (0.012)	220.2**	-0.127*	-0.134	-0.285	-0.40**	6.88**	-0.487	-7.037	0.021	7.43**	0.784
13-Stones and Cement (0.006)	92.80**	-0.029	0.103	-0.287	0.138*	-1.499*	-1.54**	-0.745	-0.208	31.82**	0.96
01-Live Animals (0.004587)	11.09	-0.054	-0.231*	1.036	-0.42**	4.118**	3.377**	3.102	0.969**	26.63**	0.952
09-Woods (0.0035)	33.84**	-0.07**	0.081	0.24	0.07	1.618	-1.3**	-5.42**	-0.5**	25.29**	0.942

Table 4.28 (Continued)

Industry (Trade Share)	Coefficient Estimates										
	Constant	PCH_t	NCH_t	$LnNEX_t$	$LnFDI_t$	$LnIR_t$	$LnRT_t$	$LnINF_t$	$LnIP_t$	F-Stat.	Adj. R^2
08-Skins and Leather (0.0018)	21.45	0.134**	-0.175	7.49**	-0.16	-1.98	1.458*	-5.854	1.408**	4.88**	0.727
12-Footwears & Umbrellas(0.0016)	-35.99**	-0.107**	0.079	-0.043	-0.01	-1.667	0.434	-0.555	-0.191	70.71**	0.976
19-Arms and Ammunition (0.0014)	-76.95*	-0.005	-0.477*	1.247	1.175**	-3.10**	-1.131	31.98**	2.44**	2.76**	0.439
14- Precious Stones (0.000172)	-28.39	0.004	-0.303**	-4.809	-0.029	-0.282	2.051	1.127	0.276	3.51**	0.447

*A. **indicate significance level at 5%. *indicate significance level at 10%. B. PCH=Positive changes in Exchange rate volatility, NCH=Negative changes in volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. C. at the 5% (1%) significance level when explanatory variables are seven (K=7) the F-Statistics Lower bound critical values are 2.32 (2.96) and upper bounds critical values are 3.50 (4.26). These critical values are taken from Pesaran et al. (2001) Table CI Case III, Page number 36. D. The complete description of each industry is given in the notes of Table 4.24.*

4.4.5 Nonlinear Relationship Between Exchange Rate and Industry-Level Import

4.4.5.1 Basic Nonlinear Industry-Level Import Model

The basic estimates of nonlinear import based model are reported in Table 4.28. There are nine industries where either ΔPCH or ΔNCH or both in exchange rate volatility carries significant coefficients in sectors coded 11, 02, 09, 08, 12, 16, 15, 20, and 14, demonstrating that volatility of exchange rate effect Pakistan imports. This number is seven in linear import based model. Two additional sectors becomes significant after the nonlinear adjustment to the linear import based model. There are five industries coded 11, 02, 09, 08, and 12 where ΔPCH carries significant coefficients while ΔNCH does not. Likewise, there are four sectors numbered 16, 15, 20, and 14 where ΔPCH have insignificant and ΔNCH have significant coefficients. These industries indicating asymmetric effect of exchange rate volatility. Second, in almost all sectors effect of volatility is seem to be asymmetric, since either size or sign of the coefficients attached to ΔPCH are different from ΔNCH. Finally, the adjustment asymmetric or impact asymmetric is observed in every industries except two coded 08 and 07, as indicated by the significant coefficients attached to Wald test.

As there is significant differences in the coefficients of other explanatory variables in nonlinear models form linear models, therefore, these will be shortly discussed.

The nominal exchange rate carries three significant coefficients in sectors coded 15, 20, and 08, the number of significant coefficients are five in linear models. To be noted that the significant coefficients attached to NEX reduced once volatility variable is split between positive changes and negative changes. The FDI have seven significant coefficients in industries coded 16, 17, 07, 10, 04, 01, and 19. The number of significant estimates are four in linear import based model. After nonlinear mechanism in volatility measure foreign direct investment carries three more significant coefficients. Thereafter, a growing interest rate in Pakistan effect the imports of following six sectors coded 16, 15, 18, 04, 01, and 09. This number is significantly reduced from twelve in the linear import based model to just half

six significant coefficients. But on the other hand, remittances have six significant coefficients in industries coded 06, 11, 10, 13, 01, and 09 which are just two in the linear import based model. A growing inflation in Pakistan discourage the imports of six sectors coded 05, 06, 07, 20, 09, and 19. The effect of inflation on imports based model is significant in ten industries in linear import models. Lastly, industrial production effect the imports of seven industries coded 05, 11, 07, 01, 09, 08, and 19. Again two significant coefficients are in excess in the linear models.

To sum up, the number of significant estimates are increased of foreign direct investment and remittances and decreased of nominal exchange rate, interest rate, inflation, and industrial production.

Moreover, the long term cointegration of exchange rate volatility is valid in all sectors because the F-statistic value is significantly greater than Pesaran et al. (2001) upper bound critical value at 5% significance value. The only one sector 19 (Arms and Ammunition, Parts and Accessories thereof), a small sector with less than one percent market share, F-stat is in between upper and lower bound critical values so does not indicating whether there is cointeragration or not. The measure of goodness-of-fit, Adjusted R^2, is reported that indicate the explanation with the given number of explanatory variables included in the equation.

TABLE 4.29: Diagnostic Statistics Associated with Table 4.28 (Nonlinear Import Based Model)

Industry (Trade Share)	Diagnostic statistics							
	Bound	**Wald-S**	**Wald-L**	**Jarque-Bera**	**LM**	**RESET**	**CUM**	**CUMQ**
5-Minerals (0.255)	9.17**	3.21**	29.19**	0.434	5.024**	1.452	S	S
16-Machineries (0.16)	11.43**	6.22**	25.34**	1.205	1.061	4.62**	S	S
06-Chemicals (0.11)	7.09**	4.39**	31.99**	1.144	3.84	0.05	S	S
15-Metals (0.085)	6.91**	7.69**	21.09**	0.771	3	0.176	S	S
11-Textiles (0.075)	7.02**	4.68**	5.70**	2.774	1.969	2.212	S	S
2-Vegetables (0.06)	6.75**	4.74**	9.32**	20.27	5.12	0.246	S	S
17-Vehicles (0.06)	2.689	10.72**	0.92	1.057	2.06	0.769	S	U
07-Plastics (0.052)	5.23**	1.28	7.0**	0.928	2.22	0.047	S	S
03-Oils and Waxes (0.043)	3.73**	7.40**	35.33**	8.69**	3.778	1.346	S	U
20-Arts and Antiques (0.038)	3.33*	3.92**	0.89	2.201	4.39**	0.018	S	S
10-Pulps of Wood (0.0158)	11.17**	6.77**	0.31	1.384	0.968	3.86**	S	S
18-Optical and Photographic (0.02)	8.29**	3.90**	5.61**	0.535	1.25	0.237	S	S
04-Foodstuffs (0.012)	7.22**	4.06**	30.92**	3.279	2.94	1.055	S	S
13-Stones and Cement (0.006)	3.62**	3.61**	0.72	1.626	1.174	0.995	S	S
01-Live Animals (0.004587)	5.797	5.06**	19.27**	1.002	0.949	0.002	S	S
09-Woods (0.0035)	6.24**	1.71	2.39	0.017	3.12	1.65	S	S
08-Skins and Leather (0.0018)	2.45	5.03**	0.86	0.245	1.088	5.97**	S	S
12-Footwears & Umbrellas(0.0016)	6.06**	4.87**	29.83**	0.1898	2.65	0.246	S	S
19-Arms and Ammunition (0.0014)	5.55**	3.23**	0.93	6.818	3.92**	3.247**	S	S
14- Precious Stones (0.000172)	6.75**	3.22**	2.35	0.051	2.355	0.895	S	S

*A. **indicate significance level at 5%. *indicate significance level at 10%. B. Trade share is the percentage of Proportionate Share of each industry in the total trade over the sample period. C. Bound is the model stability test. Jarque-Bera is the goodness-of-fit test for the sample normality. LM stands for Lagrange Multiplier is the residual serial correlation test, with one degree of freedom is distributed as X^2. REST is test is for the model misspecification it is also denoted by X^2 with one degree of freedom. CU and CUQ shows Cumulative sum and cumulative sum square tests for the stability of the Model and indicated by S for stable and U for unstable at 5% significance level. D. The particulars of all industries are provided in notes of Table 4.24.*

4.4.5.2 Diagnostic Tests for Industry-Level Import Model

A battery of diagnostic statistics are reported in Table 4.29. Where bound test show that whether the optimum import based models are stable, for which the bound estimate should be within the upper and lower critical bound. Results show that almost all models are stable indicated by the significant coefficients of bound test. Secondly, the data of all optimum models are normally distributed except for sector 03 (Animal or Vegetable Fats, Oils and Waxes), indicated by the insignificant coefficients of Jarque-Bera. Thirdly, three optimum models suffer from auto correlation while remaining seventeen industries do not face the problem of serial correlation. Fourthly, The Ramseys RESET test indicate that sixteen sectors optimum models are well specified. It is to be noted that in ARDL the significance of RESET test is not a problem. Finally, CUM show that all the model are stable indicated by S and CUMQ suggest that two industries coded 17 and 03 models are unstable as indicted by U for which dummy variables are placed in the optimum models that bring stability.

TABLE 4.30: Long-Run Coefficient Estimates of Nonlinear Industry-Level Import Model

Industry (Trade Share)	**Long-run Coefficient Estimates**								
	Constant	**PCH$_t$**	**NCH$_t$**	**LnNEX$_t$**	**LnFDI$_t$**	**LnIR$_t$**	**LnRT$_t$**	**LnINF$_t$**	**LnIP$_t$**
5-Minerals (0.255)	24.14**	-0.030+	0.053	1.036	-0.346**	0.393**	-2.137**	2.860**	0.446**
16-Machineries (0.16)	23.32**	0.036**	-0.022	0.125	0.113**	-0.256**	-0.267	-1.673**	0.188**
06-Chemicals (0.11)	-31.12**	-0.043**	0.128**	1.335	0.212	-0.267**	2.841**	-0.616	0.109
15-Metals (0.085)	23.03**	-0.011**	-0.081**	0.283	-0.025	-0.014	-0.39	-1.410*	0.205**
11-Textiles (0.075)	59.46**	0.039	-0.072	4.056	-0.520**	-0.19	-2.796**	-4.479	0.756**
2-Vegetables (0.06)	22.41*	0.001	-0.086*	-6.075**	0.164	-0.325	-1.194	5.699**	-0.198
17-Vehicles (0.06)	40.50**	-0.004	-0.176**	3.034	-0.741**	0.927**	0.339	-7.392**	0.284**
07-Plastics (0.052)	10.7**	-0.011**	0.012	-0.214	-0.063**	-0.075**	-0.134	0.754**	0.163**
03-Oils and Waxes (0.043)	-88.14**	-0.222**	0.079	-1.117	0.586**	-0.628	7.324**	-0.868	0.065
20-Arts and Antiques (0.038)	6.926	-0.038	0.007	-2.328**	0.266**	-0.351	-0.931**	4.707**	-0.036
10-Pulps of Wood (0.0158)	24.89**	0.061**	0.046**	-0.953*	-0.165**	0.322**	-1.055**	0.858	0.236**
18-Photographic (0.02)	26.98**	0.088**	0.107**	1.737**	0.041	-0.738**	-1.735**	-0.02	0.351**
04-Foodstuffs (0.012)	122.42**	-0.006	-0.529**	-4.70**	-0.819**	1.999**	-7.880**	4.224	-0.095
13-Stones and Cement (0.006)	44.09**	0.084**	0.021	-3.08**	-0.126	-0.546**	-2.998**	4.151**	0.128*
01-Live Animals (0.004587)	7.753	-0.297**	-0.543*	-4.618*	-0.319	-0.03	2.458	-2.084	-0.086
09-Woods (0.0035)	10.41**	-0.006	0.011	-1.293**	-0.034	-0.117	-0.678**	2.597**	0.088**
08-Skins and Leather (0.0018)	29.23	-0.015	-0.125	19.70**	-1.679**	0.096	4.315	-27.50**	1.328**
12-Footwears & Umbrellas(0.0016)	-9.09**	-0.016**	0.072**	-0.937*	0.023	-0.510**	-0.073	4.054**	0.097**
19-Arms and Ammunition (0.0014)	-46.15*	-0.003	0.054	-11.24**	2.072**	-1.860**	-0.679	16.88**	-0.96**
14- Precious Stones (0.000172)	-24.99	-0.167**	-0.267**	-4.233	0.792**	-0.248	1.805	3.143	-0.61**

*A. **indicate significance level at 5%. *indicate significance level at 10%. B. Pch=Positive changes in volatility, NCH=Negative changes in Exchange rate volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. C. Trade share is the percentage proportionate share of each industry in the total trade over the sample period. D. The description of each industry is provided in the notes of Table 4.24.*

4.4.5.3 Long-Term Nonlinear Relationship Between Exchange Rate and Industry-Level Import

Long-term coefficients of NARDL import based model are reported in Table 4.30. There are thirteen industries coded 16, 06, 15, 17, 07, 03, 10, 18, 04, 13, 01, 12 and 14 where either ΔPCH or ΔNCH or both carries at least one significant coefficient, showing in long-term the effect of volatility on imports of these industries. Secondly, the effect of increased uncertainty seem to be different than decrease in most of these industries thus supporting the asymmetric long term effect of exchange rate volatility on Pakistan imports. The number of significant coefficients in case of linear import based model is eight. The difference of these five more significant industries should be attributed to the nonlinear mechanism of exchange rate volatility. For example three industries 16 (Machinery and Mechanical Appliances with 16% market share), 07 (Plastics and Articles thereof; Rubber and Articles thereof with 5% market share), and 03 (Animal or Vegetable Fats, Oils and Waxes with 4% market share) where increased volatility adversely affect Pakistan long term import demand while decreasing volatility in the same sectors does not affect import demand. On the contrary, two industries coded 17 (Vehicles, Aircraft, Vessels and Associated Transport Equipment with 6% market share) and 04 (Prepared Foodstuffs; Beverages, Spirits, Vinegar and Tobacco, 1.2% market share) where decreasing volatility in the long run adversely affect imports and increasing volatility have no effect on long term imports. The long-run cumulative impact asymmetry is observed in twelve Industries, since Wald-L carries significant estimates in these industries. The other explanatory variables are shortly discussed in the subsequent paragraph.

The nominal exchange rate attached to eight significant coefficients in industries coded 02, 20, 18, 04, 13, 09, 08, and 19, same number of significant estimates in that of linear import based model. The other explanatory variable FDI have twelve significant estimates in sectors coded 05, 16, 11, 17, 07, 03, 20, 10, 04, 08, 19, and 14. The one significant coefficient is in excess in the linear import based model. As for the growing interest rate in the country the imports of industries coded 05, 16, 06, 17, 07, 10, 18, 04, 13, 12, and 19 are significantly affected. The number

of significant coefficients attached to interest rate in linear import based model are fifteen. The flow of remittances into Pakistan effect long term imports of the following sectors coded 05, 06, 11, 03, 20, 10, 18, 04, 13, and 09. The effect of remittances is observed in just five sectors in linear import based model. The rate of inflation effect the long run import demand of eleven sectors coded 05, 16, 02, 17, 07, 20, 13, 09, 08, 12, and 19 while in the linear models this number is limited to nine. Lastly, industrial production carries thirteen significant coefficients in sectors coded 05, 16, 15, 11, 17, 07, 10, 18, 09, 08, 12, 19, and 14, showing that industrial production effect the long-term import demand of these commodities.

In short, the number of significant coefficients attached to remittance and inflation increased after nonlinear mechanism in the volatility measure while the significant estimates of foreign direct investment, interest rate, and industrial production decreased.

TABLE 4.31: Short-Run Coefficient Estimates of Nonlinear Industry-Level Import Model

Industry (Trade Share)	**Short-Run Coefficient Estimates**									
	$\mathbf{LnDV}_{t-1}$	$\mathbf{LnDV}_{t-2}$	$\Delta\mathbf{PCH}_t$	$\Delta\mathbf{PCH}_{t-1}$	$\Delta\mathbf{PCH}_{t-2}$	$\Delta\mathbf{PCH}_{t-3}$	$\Delta\mathbf{NCH}_t$	$\Delta\mathbf{NCH}_{t-1}$	$\Delta\mathbf{NCH}_{t-2}$	$\Delta\mathbf{NCH}_{t-3}$
5-Minerals (0.255)	0.162		-0.0113	0.0177	0.045		0.0666			
16-Machineries (0.16)	0.631**	0.674**	-0.002	-0.014	-0.035**	-0.04**	-0.09**			
06-Chemicals (0.11)			-0.004	0.042**			0.005	-0.08**	-0.075**	-0.029
15-Metals (0.085)	1.21**	0.87**	-0.027*				-0.18**	-0.033	-0.04	
11-Textiles (0.075)			-0.16**	0.061	0.049	-0.064	0.033	-0.107	-0.204**	0.125**
2-Vegetables (0.06)	0.688**	0.127	-0.13**	0.062	-0.017	-0.052	0.003	-0.06	-0.108	0.138*
17-Vehicles (0.06)	1.38**	0.331	0.047	0.083	-0.21**	0.216**	0.039	-0.202*	0.31**	
07-Plastics (0.052)	1.288**	0.736**	-0.014	0.017	0.028		0.005	-0.01	-0.039	
03-Oils and Waxes (0.043)	0.583	0.622	0.022	-0.026	0.045	0.189*	-0.31*	-0.09	-0.106	-0.28**
20-Arts and Antique (0.038)	1.425**	1.066**	-0.136	0.232*	-0.138		0.39**	-0.191	0.173	0.151
10-Pulps of Wood (0.0158)	1.61**	1.13**	0.045**	0.041*	-0.065**	-0.047*	0.129**	-0.055	0.088**	
18-Photographic (0.02)	0.474	0.166	0.033	0.027	-0.002	-0.12**	0.071	-0.034	-0.068	
04-Foodstuffs (0.012)	0.668**	0.257	-0.127*				-0.134	0.297**	0.182	
13-Stones and Cement (0.006)	1.205**	0.599	-0.029	0.075**	-0.028	-0.14**	0.103	-0.032	0.051	0.112**
01-Live Animals (0.004587)	-0.265	-0.318	-0.054	-0.096	0.051	0.327**	-0.231*	0.281**	0.132	-0.25**
09-Woods (0.0035)	1.627**	0.919**	-0.07**	0.048	0.046	-0.16**	0.081	0.046	0.01	0.118**
08-Skins Leather (0.0018)	0.201	0.691*	0.134**	-0.26**	-0.123	0.209**	-0.175	0.13	0.188	
12-Footwears (0.0016)	2.122**	1.006**	-0.11**	-0.034	0.13***	-0.09**	0.079	-0.053	-0.186**	0.07
19-Arms and Ammunition (0.0014)	0.423**		-0.005				-0.477*	- 0.592**	-0.541**	0.261
14-Cultured Pearls & Precious Stones (0.00017)			0.004				-0.30**			

Table 4.31 (Continued)

Industry (Trade Share)	Short-Run Coefficient Estimates									
	$\mathbf{LNEX}_t$	$\mathbf{LNEX}_{t-1}$	$\mathbf{LnNEX}_{t-2}$	$\mathbf{LnFDI}_t$	$\mathbf{LnFDI}_{t-1}$	$\mathbf{LnFDI}_{t-2}$	$\mathbf{LnIR}_t$	$\mathbf{LnIR}_{t-1}$	$\mathbf{LnIR}_{t-2}$	$\mathbf{LnRT}_t$
5-Minerals (0.255)	0.7086	4.028**	-1.945	-0.033	0.168**	0.0176	-0.314	0.4815	-0.846	0.128
16-Machineries (0.16)	0.48	2.292**	-2.94**	0.17**			0.99**			-0.178
06-Chemicals (0.11)	-0.9	-1.481	2.763**	0.015	-0.036	0.001	0.577	-0.456	0.076	0.75**
15-Metals (0.085)	2.218**	3.73**	-3.31**	0.056	0.002	-0.08**	1.85**	0.982		0.209
11-Textiles (0.075)	-0.397	8.178**	-7.989**	-0.154*			-1.635	6.877**	-7.11**	-1.59**
2-Vegetables (0.06)	-3.56	7.92**	-2.311	-0.081	-0.103	-0.077	2.44			-0.611
17-Vehicles (0.06)	4.58	-0.809	-1.136	-0.55**	0.192	0.436**	1.82	7.30*	-8.69*	0.783
07-Plastics (0.052)	0.742	0.238	-0.483	-0.10**			-0.058	0.827	-0.91	-0.018
03-Oils and Waxes (0.043)	0.687	-6.88**	1.575	-0.263*	-0.306*	-0.146	4.51	1.288	-4.835	1.35
20-Arts and Antiques (0.038)	-6.8**			0.187	-0.52**		2.419			-1.756
10-Pulps of Wood (0.0158)	-0.293	-1.498	-2.286	-0.21**	-0.068	0.123**	1.405	2.978	-4.541**	-1.09**
18-Photographic (0.02)	1.668	1.04	-2.083*	0.076			-3.84**	2.99	1.26	-0.56
04-Foodstuffs (0.012)	-0.285	-3.4	-3.712	-0.40**	0.121	0.407**	6.88**			-0.487
13-Stone and Cement (0.006)	-0.287	3.87**	-1.78	0.138*	0.003	0.113*	-1.50*	4.59**	-2.39	-1.5**
01-Live Animals (0.004587)	1.036	-2.024	8.866**	-0.42**	0.182	-0.146	4.1**	-1.904	1.786	3.37**
09-Woods (0.0035)	0.24			0.07	-0.062	0.155**	1.618	3.872	-3.022	-1.32**
08-Skins and Leather (0.0018)	7.488**	3.649	-3.684	-0.16	0.455**	0.289**	-1.98	-9.66**	7.355**	1.458*
12-Footwears (0.0016)	-0.043	-0.695	6.131**	-0.01			-1.667	3.979**		0.434
19-Arms and Ammunition (0.0014)	1.247	25.51**		1.17**	-0.89**	-1.069**	-3.10**			-1.131
14-Cultured Pearls & Precious Stones (0.00017)	-4.809			-0.029	-0.453**		-0.28			2.051

Table 4.31 (Continued)

Industry (Trade Share)	Short-Run Coefficient Estimates								
	$\mathbf{LnRT}_{t-1}$	$\mathbf{LnRT}_{t-2}$	$\mathbf{LnINF}_{t}$	$\mathbf{LnINF}_{t-1}$	$\mathbf{LnINF}_{t-2}$	$\mathbf{LnIP}_{t}$	$\mathbf{LnIP}_{t-1}$	$\mathbf{LnIP}_{t-2}$	$\mathbf{ECM}_{t-1}$
5-Minerals (0.255)	0.515	0.1855	11.0**			0.81**	0.089	0.1684	-1.27** (-7.66)
16-Machineries (0.16)	-0.008	0.263*	-1.97*	-3.63**	3.401*	0.261	0.044	-0.049	-1.85** (-8.11)
06-Chemicals (0.11)	-1.1**	-0.961**	4.49**	4.124*	1.763	0.268	0.623	0.022	-1.20** (-6.76)
15-Metals (0.085)	0.389		-2.194	-0.047	-5.97**	0.305*	0.109	0.351**	-2.50** (-7.13)
11-Textiles (0.075)			1.299	-10.7**	-5.854	0.63**			-0.83** (-5.36)
2-Vegetables (0.06)	0.907	0.751	7.12*	-7.045	-3.771	-0.24	0.049	-0.396	-2.12** (-5.22)
17-Vehicles (0.06)	0.127	0.169	3.47	-22.9**	24.85**	0.075	-0.32	0.395	-2.49** (-2.82)
07-Plastics (0.052)			2.36**			0.33**			-2.72** (-5.73)
03-Oils and Waxes (0.043)	-1.9**	-2.34**	-0.989	10.55**		1.07**	1.41**	0.928*	-1.57** (-5.39)
20-Arts and Antiques (0.038)			16.8**	-17.8**		0.554	-0.515	-0.986	-2.93** (-5.57)
10-Pulps of Wood (0.0158)	1.107**	-0.552**	-0.636	-4.858	6.837*	0.232	-0.54**		-2.83** (-7.04)
18-Photographic (0.02)	1.02**	0.288	-0.037			0.071	0.116	-0.295	-1.87** (-4.50)
04-Foodstuffs (0.012)	3.81**	4.58**	-7.037			0.021	-0.755		-1.79** (-6.39)
13-Stones and Cement (0.006)	1.55**	1.17**	-0.745	-4.71	-4.127	-0.208	-0.334	-0.63**	-2.11** (-3.54)
01-Live Animals (0.004587)	0.011	-0.226	3.102	4.479		0.97**	0.880*	0.387	-1.43** (-3.22)
09-Woods (0.0035)			-5.423**	1.091	-12.22**	-0.56**	-0.73**		-3.25** (-6.14)
08-Skins and Leather (0.0018)			-5.854	-2.98	22.03**	1.408**	0.256	0.225	-0.73** (-2.56)
12-Footwears (0.0016)			-0.555	-1.469	-11.17**	-0.191			-3.95** (-6.27)
19-Arms, Ammunition (0.0014)			31.9**	-44.3**	-14.83	2.44**			-1.66** (-6.81)
14-Cultured Pearls (0.0002)			1.127	-15.71	27.357**	0.276	0.625	-0.938	-1.14** (-8.49)

*A.**indicate significance level at 5%. *indicate significance level at 10%. B. Trade share is the percentage proportionate share of each industry in the total trade over the sample period. C. PCH=Positive changes in Exchange rate volatility, NCH=Negative changes in volatility, NEX=Nominal exchange rate, FDI=Foreign direct investment, IR=Interest rate, RT=remittances, INF=Inflation, IP=industrial production. D. The Particulars related to each industry are given in the notes of Table 4.24. E. The t-ratio values are given in the parentheses next to ECM_{t-1}. The t-ratio upper bound critical values at 5% (1%) significance level when exogenous variables are seven (k=7) are -4.57 (-5.19) and lower bounds are -2.86(-3.43). These values are taken from the Pesaran et al. (2001) Table C 02, case III, and page number 38.*

4.4.5.4 Short-Term Nonlinear Relationship Between Exchange Rate and Industry-Level Import

Short-term coefficient estimates obtained from nonlinear import based model are reported in Table 4.31. From this table, first collected that there are now eighteen industries out of total 20 industries in which either ΔPCH or ΔNCH or both carry at least one significant short term level or lag coefficient, demonstrating short term effect of volatility on Pakistan imports. This number is fifteen in linear import based model. Thus, once decrease volatility is separated form increase volatility additional three coefficients becomes significant this should be attributed to the nonlinear adjustment to the volatility variable in import based model. Second, short-term asymmetry adjustment is noted in eleven industries coded 05, 16, 06, 15, 17, 07, 10, 18, 04, 08, and 19, since the lag order followed by ΔPCH is different from ΔNCH. Thirdly, short-term asymmetric effect is observed in almost every industry, since either size or sign of coefficient attached to ΔPCH at each lag is different from the same of ΔNCH. Finally, short term impact asymmetry is establish in eighteen industries out of total twenty industries, since Wald-S carries significant coefficients reported in Table 4.27.

The nominal exchange rate carries 13 significant short run coefficients in industries coded 05, 16, 06, 15, 11, 02, 03, 20, 13, 01, 08, 12, and 19, implying that a change in NEX effect Pakistan imports in short term. This number is also eleven in linear specifications. Thus after nonlinear specification in volatility measure the number of significant coefficients increased. As for the growing foreign direct investment in Pakistan, the imports of thirteen sectors coded 05, 16, 15, 17, 07, 20, 10, 04, 01, 09, 08, 19, and 14 are effected. The number of significant estimates are twelve in the linear model. The coefficients of interest rate are significant in eleven industries coded 16, 15, 11, 10, 18, 04, 13, 01, 08, 12, and 19. These short term significant estimates are fourteen in the linear import based model. The growing remittances in the short run effect the imports of nine sectors coded 06, 11, 03, 10, 18, 04, 13, 01, 08, 12, and 19 indicated by the significant coefficients at either lag. After the introduction of nonlinear adjustments to the volatility measure the rate of inflation effect two additional sectors imports significantly, since the number

of significant coefficients are fourteen which is twelve in the linear import based model. The growing industrial production in Pakistan effect in the short run the imports of ten sectors coded 05, 15, 11, 07, 03, 10, 01, 09, 08, and 19. The effect of industrial production in linear import model are significant in nine industries.

To sum up, nominal exchange rate, foreign direct investment, remittances, inflation, and industrial production carries more and only interest rate carries less number of significant coefficients in the nonlinear industry-level short term import based model than that of linear import based model.

Finally the estimates of ECM_{t-1} are significant and negative supporting the long-term cointegration in all importing industries. While t-ratio estimates associated to error correction model where null hypothesis of no cointegration is supported in two sectors 17 and 08, and the decision of long-term cointegration inconclusive in three sectors coded 18, 13, and 01, since the estimates are in between the upper and lower bound critical values of Pesaran et al. (2001).

4.4.6 Summary of Results

This section provide a brief of all the linear and nonlinear models. This section has three parts. The first part is about the short-term and long-term symmetric and asymmetric effect of exchange rate volatility on Pakistan aggregate trade flows. Second part deals with the short-term and long-term symmetric and asymmetric effect of exchange rate volatility on Pakistan 20 exporting industries. Third part show the short and long-term symmetric and asymmetric effect of exchange rate volatility on Pakistan 20 importing industries.

4.4.6.1 Effect of Exchange Rate Volatility on Pakistan Aggregate Trade Flows

The results indicate that there is significant long-term asymmetric effect of exchange rate volatility on aggregate trade, since the coefficient attached to NCH_t is significant. The long-term symmetric effect of volatility is insignificant, indicated by the coefficient attached to LnV_t. Further, the significant coefficient of Wald-L

TABLE 4.32: Long-Term Coefficients of Linear and Nonlinear Aggregate Trade Flow

Particulars	**Long-Term Coefficient Estimates**			
	LnV$_t$	**PCH**$_t$	**NCH**$_t$	**Wald-L**
Ln Aggregate Trade	0.006	0	0.027**	18.67**
Ln Export	0.018**	-0.038	0.08**	15.35**
Ln Import	-0.007	-0.018	0.02	13.15**

supporting long-run cumulative or impact asymmetric of exchange rate volatility in aggregate trade.

Likewise, there is significant symmetric and asymmetric effect of exchange rate volatility on Pakistani total exports. Additionally, cumulative effect asymmetric of volatility on exports. On the other hand, there is neither long-term linear or nonlinear effect of exchange rate volatility on Pakistani imports, but the long-term cumulative effect of exchange rate volatility on imports is present.

TABLE 4.33: Short-Term Coefficients of Linear and Nonlinear Aggregate Trade Flows

	Short-Term Coefficient Estimates					
Particulars	**LnV**$_t$	**PCH**$_t$	**PCH**$_{t-1}$	**NCH**$_{t-1}$	**NCH**$_{t-3}$	**Wald-S**
Ln Trade	0.01	-0.014	0.020**	-0.031	-0.012	4.53**
Ln Export	0.018**	0.018**	0.007	-0.028**	-0.075**	6.43**
Ln Import	-0.008	-0.03**	0.037**	-0.05**		5.70**

The short-run coefficients of linear and nonlinear aggregate trade flows are reported in Table 4.33. The results show short-term asymmetric effect, short-run cumulative impact, and short-run adjustments of exchange rate volatility in aggregate trade. There is no symmetric effect of exchange rate volatility on Pakistani aggregate trade flows.

The results indicate significant short-term symmetric and asymmetric effect of exchange rate volatility on Pakistan exports as well as short-run adjustment and short-run impact asymmetric in exports is observed. Likewise, there exist significant short-run asymmetric effect, short-run cumulative effect, and short-run

adjustment asymmetry in Pakistan imports but the symmetric effect of volatility on imports is found insignificant.

4.4.6.2 Effect of Exchange Rate Volatility on Pakistan Industry-level Exports

This section provide a brief of the linear and nonlinear effect of volatility on Pakistan all exporting industries.

TABLE 4.34: Long-Term Symmetric and Asymmetric Effect of Volatility on Exporting Industries

Coefficients	**Long-Term Effect of Volatility**				
	LnV$_t$	**PCH$_t$**	**NCH$_t$**	**Total Significant**	**Wald-L**
Significant	11	10	7	13	14
Positive	7	5	6		
Negative	4	5	1		

In the Table 4.34 the linear and nonlinear effect of volatility on the number of Pakistan exporting industries is reported. The results conclude that there is long-term symmetric effect of exchange rate volatility on eleven Pakistan exporting industries. In these eleven industries the effect of exchange rate volatility is positive in seven industries and negative in remaining four industries. Among the significant positive effect industry 02 (Vegetable products) and industry 05 (Mineral products) are the large industries with market share of 11% and 5.3% respectively. Once the nonlinear adjustment is introduce in the volatility measure, by separating increase volatility from decrease volatility, there is now significant effect of exchange rate volatility in thirteen exporting industries. The two industries, Industry 06 (Chemicals) and 17 (Vehicles), becomes significant after nonlinear adjustments to the volatility measure, where PCH has negative and NCH has positive significant coefficients, implying that positive changes in exchange rate volatility has different effect than negative changes in exchange rate volatility. In short, the nonlinear results indicate long-run effect in thirteen, long-run cumulative effect in fourteen, and long-run asymmetric effect in almost all exporting industries of Pakistan.

TABLE 4.35: Short-Term Symmetric and Asymmetric Effect of Volatility on Exporting Industries

Coefficients	**Short-Term Effect of Volatility**				
	LnV$_{t-j}$	**PCH**$_{t-j}$	**NCH**$_{t-j}$	**Total Significant**	**Wald-S**
Significant	12	14	11	18	17
Positive	6	8	5		
Negative	3	5	6		
Mixed	3	1	-		

In Table 4.35, the results show significant short-run effect of exchange rate volatility in twelve exporting industries in the linear models and in eighteen exporting industries in the nonlinear models. The significant linear effect of volatility in the short-run is positive in six and negative in three industries. In the positive effect of exchange rate volatility industry 05 (Mineral products, 5.3% market share) and 08 (Raw hide and Skins, 4.7% market share) are the large industries. Further the results conclude short-run asymmetric effect in eighteen, short-run cumulative effect in seventeen, short-run adjustment asymmetry in fourteen exporting industries of Pakistan.

4.4.6.3 Effect of Exchange Rate Volatility on Pakistan Industry-level Imports

In this section first the long-term symmetric and asymmetric effect of volatility and then short-term on all Pakistan importing industries.

TABLE 4.36: Long-Term Symmetric and Asymmetric Effect of Volatility on Importing Industries

Coefficients	**Long-Term Effect of Volatility**				
	LnV$_{t}$	**PCH**$_{t}$	**NCH**$_{t}$	**Total Significant**	**Wald-L**
Significant	10	11	8	13	12
Positive	6	4	4	7	
Negative	4	7	4	4	

Now the long-term effect of exchange rate volatility in number of importing industries is reported in Table 4.36. The results show symmetric effect of exchange rate

volatility on ten Pakistan importing industries. The effect of volatility is positive in six and negative in four importing industries of Pakistan. In the list two largest industries 16 (Machinery and Mechanical Appliances, with 16% market share) and 15 (Base Metals and Articles, with 8.5% market share) imports more in time of higher exchange rate volatility. While industry 11 (Textiles and Textile Articles, with 7.5% market share) import less in case of higher exchange rate volatility. In the nonlinear models, the results express long-term effect of volatility in thirteen industries, long-run cumulative or impact asymmetric in twelve, and long-term asymmetric effect in almost all importing industries of Pakistan. Industry 06 (Chemicals) and 12 (Footwear's) coefficients becomes significant after nonlinear adjustments to the volatility measure, where PCH has negative and NCH has positive significant coefficients, implying that positive changes have different effect than negative changes in exchange rate volatility.

TABLE 4.37: Short-Term Symmetric and Asymmetric Effect of Volatility on Importing Industries

Coefficients	**Short-Term Effect of Volatility**				
	LnV$_{t-j}$	**PCH**$_{t-j}$	**NCH**$_{t-j}$	**Total Significant**	**Wald-S**
Significant	15	14	11	18	18
Positive	6	8	5		
Negative	8	5	6		
Mixed	1	1	-		

In the Table 4.37, the number of industries importing industries are reported where either there is symmetric or asymmetric effect of exchange rate volatility. The results show significant positive linear effect of exchange rate volatility in six and negative in eight importing industries of Pakistan. Two industries 05 (Minerals Products, 25% market share) and 16 (Machinery and Mechanical Appliances, with 16% market share) in the short-run increase imports in time of higher exchange rate volatility. After the nonlinear adjustment there are now eighteen industries where exchange rate volatility has a short-run significant effect. Further short-run cumulative effect in eighteen, short-run adjustments in eleven, and short-term asymmetric effect of exchange rate volatility in almost all importing industries of Pakistan.

Chapter 5

Discussion and Policy Implications

5.1 Discussion

The aim of this study is to first investigate the symmetric and asymmetric effect of exchange rate volatility on aggregate trade, imports, and exports. Second, to examine the symmetric and asymmetric effect of exchange rate volatility on exporting industries and importing industries of Pakistan as determined by State bank of Pakistan (SBP) on commodity level. This study used two methodologies, first the Pesaran et al. (2001) linear autoregressive distributed lag (ARDL) and second the nonlinear autoregressive distributed lag (NARDL) of Shin et al. (2014) by using quarterly data covering period Q3-2003 to Q2-2018. The exchange rate volatility is measured through Generalized Autoregressive Conditional Heteroskedasticity (GARCH) process, as volatility best follows GARCH process. By following the study of Bahmani-Oskooee et al. (2006) the maximum of four lags are used and for optimum models selection AIC is used by following general-to-specific approach. Thus, all the results belongs to each optimum model. In this study, the null hypothesis of no cointegration is tested through F-statistic, and alternatively through ECM_{t-1} by replacing the lagged level specifications in equations. The

basic, long-run, short-run and number of diagnostic statistics associated to each model are reported.

To begin with linear aggregate trade model, as for the F-statistic trade demand model is cointegrated. This cointegration is further confirmed by the negative significant coefficient of error correction model. To determine the long-run effects, exchange rate volatility has a significant positive effect on Pakistan aggregate trade at 10% significance level. The exchange rate, foreign direct investment and remittances has adverse effect on trade flows of Pakistan while the interest rate, inflation, and industrial production have positive effect on Pakistan aggregate trade.

As for the short-run effects, contrary to the expected a higher exchange rate uncertainty improves Pakistan trade, since the volatility coefficient is positively significant at 90% confidence level. Similar findings of positive significant effect of exchange rate volatility on trade flow was reported (Cushman, 1988; Sercu and Vanhulle, 1992). Other variables in the model also have short run significant effect on Pakistan trade volume include foreign direct investment, interest rate, remittances, inflation, and industrial production.

Second, the null hypothesis of no long-term cointegration do not support in linear export based model, since the estimate of F-statistic is highly significant. Further cointegration is also confirmed by the negative significant estimate of ECM_{t-1} test, an alternative test for cointegration. In Table 4.10, shows a growing volatility in the long-run encourage Pakistan exports to the world. The other explanatory variables foreign direct investment and remittances adversely affect Pakistan exports and interest rate positively affect Pakistan exports in the long-term.

To summarize the short-run results of export based model. A higher volatility increase Pakistan exports volume, since the coefficient attached to exchange rate uncertainty is positively significant. A growing exchange rate volatility significantly discourage export (Franke, 1991; Asseery and Peel, 1991; Broll and Eckwert, 1999). The effect of interest rate, inflation and economic activity is also significant on Pakistan exports.

All the coefficients estimates of export based model are supported by a number of diagnostic statistics. The optimum model does not suffer from autocorrelation indicated by the significant estimate of LM test as well as the data is normally distributed because the coefficient of Jarque-Bera is insignificant. While the coefficient of RESET test is significant suggesting model miss specification but as the study deal with long-term cointegration this may not be the problem. Finally, the model is statistically stable according to bound test, CUM, CUMQ.

Third, the cointegration is presented in import based model as for highly significant F-statistic and confirmed by the alternative cointegration test ECM_{t-1} significant negative values. The long-run coefficient of volatility in Table 4.10 is negative but insignificant. A study by Arize et al. (2000) using quarterly data by applying error correction model report significant positive effect of exchange rate uncertainty on US imports. As in case of higher nominal exchange rate, foreign direct investment, and remittances in the long-term the imports of Pakistan decreased. On the other hand, a growing interest rate, inflation, and industrial production increase Pakistan long-run imports demand, since the coefficients are positively significant.

To check the short run effect which results are reported in Table 4.11, uncertainty of exchange rate has a significant positive short run effect on imports at 10% significance level. A significant positive impact of exchange rate volatility on imports. The effect of nominal exchange rate, inflation, and industrial production is significant in the short run. The optimum model of import demand do not suffer from serial correlation or model miss specification, since both LM and RESET carries insignificant coefficients. Further the data is normally distributed indicated by Jarque-Bera insignificant estimate. Lastly, bound, CUM, CUMQ express that optimum import model is statistically stable.

Now turning the discussion toward linear industry-level export based model. Based on estimate of F-statistic the null hypothesis of no cointegration is rejected in all exporting industries because the F-statistic is higher than 3.50 upper bound critical value of Pesaran et al. (2001). The results of coinegration are consistent with a previous study of Aftab and Rehman (2017), using monthly data and

GARCH process for volatility measurement, they observed cointegration through F-statistic in 27 exporting industries of Malaysia out of total 65 industries.

Further extending the discussion to short and long run effects. There is short-run significant effect of uncertainty on the export of 12 sectors. Similarly, short-run significant effect of uncertainty on 30 exporting industries among 97 total industries was reported by the study of Aftab et al. (2017). In case of growing exchange rate uncertainty Pakistan exports less of six industries and more in 3 industries while remaining 3 sectors show varying behaviour by carrying positive and negative significant lagged level coefficients. A mixture of negative and positive short-term significant effect of volatility on exporting sectors is supported by the study of Aftab and Rehman (2017). The long-run significant effect of volatility is present in eleven industries. The significant long-run effect of uncertainty on exporting industries is consistent with the study of Aftab et al. (2017). Exchange rate uncertainty in the long-run have significant positive effect on the exports of 8 industries and negative significant effect on remaining 4 sectors. Similarly the study of Aftab and Rehman (2017) reported significant positive effect of uncertainty in 6 and significant negative effect of uncertainty on 4 exporting industries out of total 65 industries. Similarly, the findings of Aftab et al. (2012) show long-run negative significant effect of volatility on Pakistan exporting industries.

A number of diagnostic statistics support data for further analysis. Where all significant coefficients are free from serial correlation indicated by the insignificant estimates of LM test. Further all the optimum models are almost well specified, since the RESET have insignificant estimates. Moreover, the data of all exporting industries is normally distributed. Finally, the bound, CUM, and CUMQ tests suggest significant models stability.

In importing industries, the F-statistic does not support the null hypothesis of no cointegration in 18 industries out of total 20 importing industries. The results are in line with the study of Aftab et al. (2017), who reported cointegration in 30 out of total 61 importing industries. As for the short run effect 15 industries volatility estimate is significant. Similarly Aftab et al. (2017) report short-run significant effect of volatility on importing industries of Malaysia. When there

is high volatility in the short-run Pakistan import more in 8 sectors and less on other 6 sectors while one sector have both positive and negative coefficients indicate mix response to volatility. Short-run mixture of positive and negative significant effect of exchange rate uncertainty on various importing industries was reported by Aftab and Rehman (2017). In the long-run the effect of exchange rate volatility is significant in 8 importing industries. Among 10 out of total 61 industries significant effect of uncertainty on imports was also observed by the study of Aftab et al. (2017). In long-run significant effect of exchange rate volatility on Pakistan importing industries, the effect is positive in 6 industries and negative in just 2 sectors. As mentioned before the study of Aftab et al. (2017) reported significant negative effect of volatility on 7 exporting industries and positive significant in other 3 industries. Likewise, the study of Aftab and Rehman (2017) reported significant positive effect of exchange rate uncertainty on 8 importing industries and negative significant effect of volatility on 2 importing industries. The importing industries optimum models are validated by a battery of diagnostic statistics. The insignificant LM statistic show all models free from autocorrelation except two sectors coded 17 and 10. The Jarque-Bera and RESET test indicate data normality and optimum models well specification respectively. Finally the optimum models are statistically stable at 5% significance level as for the bound, CUM, and CUMQ model stability testing.

To summarize linear models long-run effects so far, it is clear that exchange rate uncertainty has a significant effect on 11 exporting and 8 importing industries out of each total 20 industries. The findings are similar to the study of Bahmani-Oskooee and Harvey (2011), who by using annual data and different measure for volatility of exchange rate report significant effect of volatility on 10 exporting sectors out of total 20 sectors and significant effect of uncertainty on imports of 38 industries out of 101 industries. The long-term results are further supported by a similar study of Bahmani-Oskooee and Aftab (2017). They used monthly data and GARCH process to measure exchange rate volatility and report significant long run effect of exchange rate volatility on 13 exporting industries of Malaysia out of total 54 industries and long-term significant effect of uncertainty on 35 importing

industries out of total 63 importing industries of Malaysia.

Now to summarize the short run effects of exchange rate volatility. The volatility of exchange rate has a short-run significant effect on 12 (20) exporting industries and significant effect of uncertainty on 15 (20) Pakistan importing industries. These short-run results are supported by the study of Aftab, Syed, and Kapter (2017) who by using monthly data from 2000-2013 report short-run significant effect of exchange rate volatility on 30 exporting industries out of total 63 exporting industries and significant short-run effect of volatility on 13 importing industries in total 61 importing industries. Another study of Aftab et al. (2017) report significant short-run effect of exchange rate volatility on 16 exporting industries among 65 total and short-run coefficient of volatility has significant in 21 importing industries among 65 total industries.

Now going towards the second section asymmetric effect of exchange rate volatility first on aggregate trade, exports, imports, and second on 20 exporting and 20 importing industries of Pakistan. The discussion first start with the nonlinear aggregate trade model, as for F-statistic and ECM_{t-1} trade demand model is cointegrated. Looking at long run effect of uncertainty on trade flow. Where ΔNCH, decreasing volatility, has a long-run significant positive effect on Pakistan trade flow while ΔPCH, increasing volatility, does not affect trade flow, implying that decreasing volatility encourage Pakistan trade flow in the long-run and increasing volatility do not so. Further the size of ΔPCH is different form ΔNCH, thus, there is long-run asymmetric effect of exchange rate volatility on Pakistan trade flow. Additionally, the estimate of Wald-L is significant supporting cumulative adjustment asymmetry or impact asymmetry. The coefficient attached to volatility was insignificant in the linear trade based model. The growing interest rate and economic activity in the country positively affect trade flows while foreign direct investment has a negative significant effect. As for the short run asymmetric effect the estimate of ΔPCH is significant while ΔNCH also significant but at 90% confidence level, supporting the effect of exchange rate volatility on Pakistan trade flow. Second, adjustment asymmetry is observed, since ΔPCH follows different lag order than ΔNCH. Third, asymmetric effect is observed since the size or sign

of ΔPCH is different than ΔNCH at each lag. Finally, impact asymmetry is there indicated by the significant estimate of Wald-S. The other variable in the model, exchange rate, interest rate, inflation, and industrial production have a significant short-run effect on Pakistan trade flow.

Furthermore, the optimum model of aggregate trade is free from serial correlation and model misspecification indicated by the insignificant estimates of LM and RESET respectively. Moreover, model is statistically stable as for CUM, CUMQ and bound test and data is normally distributed since Jarque-Bera carries insignificant estimate.

Secondly, the discussion is of nonlinear export based model. Where long-term positive significant estimate of ΔNCH and negative insignificant coefficient of ΔPCH, suggest that once decomposition of volatility measure into increasing and decreasing volatility indicate that decreasing volatility encourage Pakistan exports volume while increasing volatility do not significantly affect Pakistan exports. The size and sign of ΔPCH are significantly different from ΔNCH, showing long-run asymmetric effect of exchange rate uncertainty on Pakistan exports. Further, the significant Wald-L estimate in Table 4.21 show long run cumulative adjustment asymmetry. In long-run foreign direct investment, remittances, and economic activity has a significant positive effect on Pakistan export volume. First, in short-run ΔPCH has a significant positive effect and ΔNCH has a significant negative effect of Pakistan exports, implying that increasing volatility encourage Pakistan exports and decreasing volatility discourage Pakistan short-term export volume. Second, adjustment asymmetry is observed since the lag order follows by ΔPCH is different from ΔPCH. Thirdly, short-run impact asymmetric is noted indicated by the significant coefficient of Wald-S in Table 4.21. Finally, as either size or sign at each lag associated to ΔPCH is different from ΔNCH, thus, supporting short-run asymmetric effect of exchange rate uncertainty on Pakistan total exports. The short-term coefficient estimates of foreign direct investment, interest rate, remittances, and industrial production are significant suggesting significant effect on Pakistan export volume. A number of diagnostic statistics associated to nonlinear export based model are reported in Table 4.21. The model do not

suffer from serial correlation and correctly specified since the coefficient estimates of LM and RESET tests are insignificant. Further, model stability is suggested by significant bound test, and CUM while CUMQ do not show model stability.

Thirdly, the nonlinear model of import demand is subsequently reported. Where the long-run coefficient estimate attached to ΔPCH is negatively significant and ΔNCH is positively significant, both significant at 90% confidence level, implying that increasing volatility reduce Pakistan long-term import demand while decreasing volatility improve Pakistan imports. The long-run asymmetric effect of exchange rate uncertainty on import volume is observed since both size and sign of ΔNCH different from ΔPCH. Additionally, the long-term impact asymmetry of uncertainty is supported by the significant coefficient of Wald-L. The effect of industrial production on Pakistan aggregate import trade is positively significant, implying that increasing economic activity in Pakistan encourage industries to import more. In short-run the coefficients of ΔPCH and ΔNCH are significant, demonstrating the significant effect of uncertainty on Pakistan import. Secondly, the number of lags associated to ΔPCH are different from ΔNCH indicating short-run adjustment asymmetry. Thirdly, short-term cumulative asymmetry or impact asymmetry is observed, since the coefficient estimate of Wald-S is significant showing that sum of the short-term coefficients from ΔPCH is not equal to the short-term sum of coefficients from ΔNCH. Finally, the size or sign attached to ΔPCH has different from ΔNCH supporting the short-run asymmetric effect of exchange rate variability on Pakistan total import volume. The significant short-run effect of nominal exchange rate, foreign direct investment, interest rate, inflation, and industrial production on total import demand is observed, since the coefficients attached to these variable are significant. A battery of diagnostic statistics support these results reported in Table 4.21. The import demand model residuals are do not serially correlated and the model is correctly specified, since LM and RESET tests estimates are insignificant. The insignificant coefficient of Jarque-Bera show that data is normally distributed. Finally, the model is statistically stable as for the significant bound test, cumulative sum, and cumulative sum of square.

From Table 4.26, first gather that there are now 13 industries where either

ΔPCH or ΔNCH or both carries at least one significant coefficient, implying the long-run effect of uncertainty on Pakistan exports volume. Second, the results of Wald-L in Table 4.25 is significant in 14 exporting industries suggesting long-run impact asymmetry. Finally, either the size or sign associated to ΔPCH is different from ΔNCH in almost every exporting industry suggesting long-run asymmetric effect of volatility on Pakistan industry-level exports. The long-run asymmetry effect of volatility on industry-level exports is supported by the study of by Bahmani-Oskooee and Aftab (2017). Additionally, a similar study of Verheyen (2013) reports long-run asymmetric effect of exchange rate in five cases out of total 12 exporting industries, implying that exports do react stronger to depreciation than appreciation.

Other explanatory variables also carries more long-run significant coefficients than the significant coefficients in the linear model, these significant cases should be attributed to the nonlinear adjustments to the volatility measure. First, as for the short run effect of uncertainty there are now 18 industries from 20 total exporting industries where at least one significant coefficient is attached to either ΔPCH or ΔNCH or both, implying that these industries respond differently to increasing volatility than decreasing volatility. The number of significant coeffficients were 12 in linear industry-level export based model. Short-term adjustment asymmetry in 14 industries and impact asymmetry in 16 sectors is observed. Finally, in 14 industries impact asymmetry is noted. Thus, supporting the short-run asymmetric effect of exchange rate volatility on industry-level export based model. All the results of nonlinear industry level export based model are consistent with the study of Bahmani-Oskooee and Aftab (2017).

The short-run coefficient estimates of other exogenous variables in the model are also significant suggesting the effect on industry-level nonlinear export based model. To validate the short-run and long-run estimates of nonlinear industry-level export based model a number of diagnostic statistics are reported in Table 4.25. Almost all optimum models are free from serial correlation and further models are correctly specified indicated by the insignificant estimates of LM and RESET test.

The data is normally distributed detected through Jarque-Bera test. Finally, the models are statistically stable as for the CUM, CUMQ, and bound test.

In importing industries either ΔPCH or ΔNCH or both carries long-term significant coefficients in 13 industries, implying that these industries respond differently to increasing volatility than decreasing volatility. The number of significant estimates were 8 in the linear import based model. These additional significant estimates should be attributed to the nonlinear adjustments in the model. Further the significant coefficient of Wald-L in Table 4.29 show long-run impact asymmetry in 12 importing industries of Pakistan. Lastly, either size or sign attached to ΔPCH are different from ΔNCH of almost all importing sectors of Pakistan, thus, supporting alternative hypothesis of asymmetric effect of exchange rate uncertainty on various importing industries. A recent study of Bahmani-Oskooee and Aftab (2017) support the results by reporting significant long-run asymmetric effect of exchange rate uncertainty on 37 out of 63 Malaysian importing industries from US.

There are other explanatory in the nonlinear import based model that also carries long-term significant coefficients indicating the effect on Pakistan industry-level import demand. Extending the discussion to short-run nonlinear effect of uncertainty which results are reported in Table 4.31. First, there are now 18 sectors where either ΔPCH or ΔNCH or both carries at least one significant short-term coefficient, demonstrating short-run effect of uncertainty on industry-level import demand. The number of significant coefficients were 15 in the linear short-term import based model. Second, short-run adjustment asymmetry is observed in 11 sectors as ΔNCH follows different lag order than ΔPCH. Thirdly, the cumulative adjustment asymmetry is observed in 18 industries. Finally, either the size or sign at either lag attached to ΔPCH is different from ΔNCH, implying short-run asymmetric effect of exchange rate uncertainty on Pakistan industry-level import demand. The short-term results of this study are consistent with the findings of Bahmani-Oskooee and Aftab (2017) who reports short-run asymmetric effect of exchange rate volatility in all 97 Malaysia importing industries from US.

Short term coefficient estimates associated with other explanatory variables in nonlinear import based model are reported in Table 4.31 and suggest significant effect on Pakistan industry-level import demand. To validate the short and long-run coefficients a number diagnostic statistics are reported in Table 4.29. Almost all the optimum models are free from serial correlation, since the LM statistic is insignificant and models are correctly specified indicated by RESET test. The data is normally distributed in these model supported by the insignificant estimates of Jarque-Bera. Finally, the import based models are statistically stable reported by bound, CUM, and CUMQ tests.

5.2 Policy Implications

This study is useful in number of ways. First, the findings of this study suggest that Pakistan trade flows, both import and export, can be managed effectively by achieving and maintaining a stable competitive exchange rate. As there exist significant adverse effect of exchange rate volatility on Pakistan aggregate and disaggregate trade flows which causes industries to trade less. Further, there exist nonlinearities in exchange rate which affecting Pakistan trade flows. Secondly, this study facilitate traders in making effective international trade decisions by considering the effect of exchange rate volatility, economic activity, foreign direct investment, growing inflation, interest rate, and flow of remittances to the country in their respective industry, to better forecast and then allocate resources accordingly. Like exchange rate volatility has a significant positive effect on the imports of industry 16 (Machinery and Mechanical Appliances, with 16% market share) both in short-term and long-term. While on the other hand exchange rate volatility has a significant long-term symmetric and asymmetric effect on the imports of industry 11 (Textiles and Textile Articles, with 7.5% market share). Thirdly, this study can be helpful for Pakistan policy makers to devise policies accordingly to resolve a severe Pakistan a balance of payment issue by addressing the nonlinearities in exchange rate and focusing on each industry trade flows. Because the effect of exchange rate is different from industry-to-industry, in some industries

the effect is positive and in others negative. Last but not least, the findings of this study show that what Pakistan importing and exporting industries might benefit or worsen from exchange rate volatility, exchange rate, foreign direct investment, interest rate, remittances, inflation, and industrial production. Furthermore, also separate that whether increasing or decreasing volatility effect individual industry trade flow positively or negatively. Thus help the management of respective industries to forecast and implement strategies accordingly.

5.3 Future Research Directions

After this thorough study here are some suggestions for future studies in this area. One open task for further studies is to conduct analysis on Pakistan bilateral trade flows with major trading partners like China and US etc. Moreover, this would be interesting to examine the potential reason of these non-linearities in exchange rate volatility. This may be due to prices of imports and exports or due to their compositions. Further a comparative study can be conducted to measure the symmetric and asymmetric effect of volatility on aggregated and disaggregated industry-level trade flows of different countries and different time span. Similarly, the asymmetric effect of volatility seem to be industry specific and have implications for industries in other countries thus, need further investigation to arrive at general conclusion.

5.4 Limitations

The limitation of this study is data of a short time span as Pakistan industry level disaggregated data for longer period is not available. The other potential limitation is of a very diverse study of its type by therefore, compromising the conciseness of the study.

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