Final Research Thesis

Is Exchange Rate of Pak-Rupee Stationary against its Major Trading Partners? New Evidence from Fourier Unit Root Tests

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CERTIFICATE

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ACRONYMS

AIC	Akaike Information Criterion
ADF	Augmented Dickey Fuller
APPP	Absolute Purchasing Power Parity
ARIMA	Autoregressive Integrated Moving Average
BOP	Balance of Payments
CAD	Current Account Deficits
CPI	Consumer Price Index
DGP	Data Generating Process
FADF	Fourier Augmented Dickey Fuller
FER	Fixed Exchange Rate
FFF	Flexible Fourier Form
FKPSS	Fourier Kapetanios, Shin and Shell
FLER	Flexible Exchange Rate
IFS	International Financial Statistics
IMF	International Monetary Fund
KPSS	Kapetanios, Shin and Shell
LOP	Law of One Price
NER	Nominal Exchange Rate
PP	Phillips-Perron
PPI	Producer Price Index
PPP	Purchasing Power Parity
RER	Real Exchange Rate
RPPP	Relative Purchasing Power Parity
WDI	World Development Indicators
WPI	Whole Sale Price Index

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DEDICATION

I dedicate my dissertation to my beloved parents, teachers and all those who prayed for my success and a special thanks to my brother Shahzada Khan and Sisters.

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ABSTRACT

This study examines whether the real exchange rate series of Pakistan against its major trading partners can be pronounced as a stationary process. We have used newly developed Fourier ADF (FADF) and Fourier KPSS (FKPSS) unit root tests for this purpose. Fourier types of unit root tests take into account both the multiple temporary structural breaks and nonlinearity adjustment of the recommended data. These tests are applied to the real exchange rates (RERs) of Pakistan against its twenty-one major trading partner countries. We are able to reject the null hypothesis of a unit root in case of FADF and are unable to accept the null hypothesis of stationarity in case of FKPSS in most the of cases. The results of both tests disclosed that multiple structural breaks exist in most of the cases of the RERs data. Hence it is essential to incorporate these irregular temporary multiple breaks and nonlinearity adjustment in the model while testing the stationarity or non-stationarity of the RER series. This study delivers comparatively better support in favor of PPP theory as compare to most of earlier studies. We have found support for the PPP in twelve and five out of twenty-one trading partner countries in case of FKPSS and FADF unit root tests respectively, in multi-nation version during the flexible exchange rate regime. The main policy suggestion from the outcomes of this study is that the exchange rates, foreign and domestic WPI based on PPP theory are co-integrated, for that reason, to adjust to inflation differentials the authorities must use PPP theory as a long term nominal anchor.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

It is a well-known realistic fact that ordinary unit root tests are unsuccessful to reject the null of a unit root for many economic time series data. This was systematically discussed by Nelson and Plosser (1982) in their influential article, they applied Dickey and Fuller (DF) unit root test to 14 annual U.S. time series data and failed to reject the null hypothesis of a unit root in majority cases. These empirical outcomes were not improved by allowing for error autocorrelation utilizing the augmented tests of Said and Dickey (1984) or the test statistics of Phillips (1987), and Phillips and Perron (1988). Similar outcomes are obtained for several other macroeconomics time series data.

The conclusion drawn from this empirical evidence is that most aggregate economic time series data are comprising of a unit root. However, it is crucial to note that in this research work the null hypothesis is the unit root that is to be tested, and the way in which classical hypothesis testing is carried out ensures that the null hypothesis of a unit root is accepted unless there is strong evidence against it. Therefore, we can say that ordinary unit root tests are not very powerful against relevant alternatives. A number of other studies have also argued that this is certainly the case we were failed to reject the null hypothesis of a unit root. For example, DeJong et al., (1989) provided evidence that the Dickey-Fuller tests have low power against stable autoregressive alternative with roots near unity, and Diebold and Rudebusch (1990) show that they also have low power against fractionally integrated alternatives.

Bayesian examination suggested an alternative means of estimating how useful the data are regarding the presence of a unit root, by providing direct posterior evidence in support of stationarity and nonstationarity. By utilizing this approach, DeJong and Whiteman (1991) found only two of the Nelson-Plosser series to have a unit root. Phillips (1991) utilized objective ignorance priors by takeout posteriors and originate provision for stochastics trends in five of the series.

These studies recommended that, in trying to decide by the classical approaches whether time series data are stationary or nonstationary, it would be beneficial to execute tests of the null hypothesis of stationary along with tests of the null hypothesis of a unit root. This thesis also provides a straightforward test of the null hypothesis of stationary in contradiction of the alternative of a stochastic trend.

The other problems with these standard unit root tests are that these tests are not designed to consider number of structural breaks and non-linearity. Perron's (1989) influential paper made clear the significance of appropriate modelling structural breaks in testing for a unit root. It is now recognized that stationarity and unit root tests can be unacceptable when a researcher inappropriately hypothesizes the nature of any structural breaks present in the data generating process (DGP). This poses most serious problems for researchers since almost all time variant macroeconomics variables can exhibit a wide variation of unknown number of structural breaks, structural form and duration. A researcher who is uncertain about the stationary of a variable is improbable to distinguish the proper way to model the possible unknown number of breaks. However, papers such as Lee and Strazicich (2003) do not incorporate more than two structural breaks, since a test with many endogenous structural breaks is not probable to have much power. Furthermore, Prodan (2008) indicates that it can be rather challenging to correctly estimate the magnitudes and

unknown number of breaks, particularly when the multiple breaks are of opposite sign. In the same manner, tests that would also incorporate the nonlinearity of Leybourne et al., (1998) and Kapetanios et al., (2003) to allow for unknown multiple smooth structural breaks do not look like promising.

To avoid such problems, Ender and Lee; and Roorigues and Taylor recommended a Fourier unit root test based on a variation of Gallant's (1981) Flexible Fourier Form (FFF). They follow Becker et al. (2004, 2006) and demonstrate that the crucial characteristics of a data series with one or more unknown number of smooth structural breaks can frequently be captured by utilizing low frequency components from a Fourier approximation. One significant feature of the approximation method is that it is not essential to undertake the total number of breaks. Hence, instead of choosing exact dates of the multiple breaks, the total number of breaks, and the structural form of the breaks, the specification problem is transformed into incorporating the suitable frequency components into the estimating equation.

All preceding research work have revealed that the Bretton-Woods regime failed due to enormous variations in nominal exchange rate (NER) than in relative prices. Therefore, we can say on the basis of above arguments that the variations in real exchange rate (RER) series are actually due to the variations in the NER under the regime of flexible exchange rate. The high variations in RER series and uncertainty of balance of payment (BOP) since the termination of the regime of Bretton-Wood (1973) are clearly in contradiction of the expectations of the followers of flexible exchange rate system.

The Purchasing Power Parity (PPP) hypothesis postulates that the RER is stationary so that the NER and domestic and foreign level of prices of goods and

services converge to the long-run equilibrium over period of time. When all nations produce same commodity or same basket of commodities and those commodities are traded without any restrictions among the nations, under such situation, no one will trade domestic commodities for foreign commodities with the exception of one to one basis (not to consider transportation cost). In this case, the RER would always equal to one. The RER is the number foreign commodities that can be acquired in interchange for one unit of residential commodity. Actually every nation produces thousands of unlike commodities, that's why RER must be based upon the consumer price index (CPI) or wholesale price index (WPI) to measure domestic and foreign prices variations in the RER with a period of time, indicating that on average, commodities of the nation whose RER is appreciating are becoming more expensive relative to the commodities of the other nations.

The PPP philosophy was particularized and brought back in to practice by the Swedish economist Cassel (1921), so as to evaluate the equilibrium exchange rates at which countries will go back to the gold standard after the disturbance in the international trade and huge variations in the comparative product prices in several nations after the World War-I. Purchasing power parity generates an association between the variations of nation's inflation or deflation and foreign exchange rate comparative to that of foreign nations (Coakley et al., 2005). Absolute PPP can be defined as purchasing power of one unit of foreign currency is exactly equal to that of residential country. On the other hand, relative PPP is associated to the transformation in the two trading partners predicted inflation rates to the alteration in their exchange rates.

Purchasing Power Parity is the value of one unit of local currency in terms of any foreign currency. It is determined at specific point of time by the demand and

supply conditions in the market and its long-run value can be established by the comparative worth of the two currencies as specified by their respective purchasing power parity over goods and services. Thus under the system of self-sufficient paper standards the external value of a currency is said to be rest upon the domestic purchasing power of that currency comparative to that of foreign currency. In addition, exchange rates under such classification tend to be determined by the relative purchasing power of particular currencies in different regions of the world. In reality, the parity will be adjusted by the transaction cost of goods and services (i.e., duties, etc.) from one region of the world to another. The absolute purchasing power (APPP) theory assumes that the exchange rates between two currencies will be alike to the ratio of the level of prices in the two nations, when it is in equilibrium point. On the other hands, relative purchasing power parity (RPPP) theory suggests that the fluctuation in the exchange rates over the period of time should be proportional to the comparative change in the price levels in the two nations over the similar time period. If the APPP detained then RPPP will also hold, but the reverse may not hold. It is due to the existence of capital movements among countries, transportation cost, and other obstacles to the free flow of international trade.

Real exchange rate is the price of tradable goods$\left({P_t}^T\right)$ relative to the price of non-tradable goods$\left({P_t}^N\right)$; both must be expressed in home currency units, i.e. $RER_t = \left({P_t}^T/{P_t}^N\right)$ (Dorn Busch, 1974, 1980; Krueger, 1987). If we assume that there is no tax on tradable commodities and law of one price holds for the tradable commodity then ${P_t}^T = NER_t\left({P_t}^{T*}\right)$, where NER_t is the nominal exchange rate of home currency per unit of foreign currency and ${P_t}^{T*}\left({P_t}^N\right)$ is the foreign (domestic) level of prices of tradable (non-tradable) commodities. Relative price $\left(RP_t =\right.$

$P_t^{T*}/P_t^N\big)$, the RER can be express as, $RER_t = NER_t\big(P_t^{T*}/P_t^N\big) = NER_t * RP_t$. Real exchange rate can also be written as, $RER_t = NER_t(WPI_t^*/CPI_t)$, where WPI_t^*/CPI_t is the whole sale (consumer) price index of foreign (domestic) country, and a proxy for the foreign (domestic) tradable (non-tradable) commodity prices (Harberger, 1986).

The notion that similar foreign and residential commodities or set of commodities should have the same worth in terms of the same currency is recognized as PPP. Consistently, as suggested the PPP articulates that the NER should equal to the ratio of the foreign and residential price levels. There is some noticeable evidence that PPP is describable in the very long-run, but over shorter and medium period PPP does not hold. The inconvenience of PPP in the short and medium period is due to the following few reasons, that are, (1) all nations produce various set of commodities, not similar commodities that is assumed in PPP, (2) few categories of commodities are not traded across the border, (3) mostly transportation cost matter, (4) the most notable reason is the legal obstacles to the free flow of international trade that may prevent the commodities prices from being equalized in various regions of the world.

Purchasing power parity may vary steadily with features of the countries and the reasons behind that are; countries having a free flow of trade may hold better for PPP because trade barrier might hold back international arbitrage and amongst nations that are geographically nearer for the reason that extraordinary transportation expenses related with larger remote areas might be avoid. Countries having a similar inflation rates may cause PPP to hold because, countries having a different inflation rates might avoid their NERs from adjustment to parity. In advanced countries, PPP might hold better amongst countries with comparatively low NER fluctuations because

stringencies may avoid prices from adjusting to parity. On the other hand, in emerging nations, with low NER fluctuations might indicate limitations on exchange rate volatility that avoid PPP to hold its grip. To end with, Samuelson (1964) and Balassa (1964) postulated that RERs appreciate in those countries that have high productivity growth in the traded goods. Therefore, PPP might not hold among the countries that have low growth and high growth productivity.

Numerous research studies have reflected that how nations characteristics may distress PPP. Lai and Cheung (2000) suggested that per capita GDP growth and free flow of international trade could not illustrate the determination of abnormalities from PPP. They also pointed out that there is negative correlation between perseverance of deviations from PPP and inflation; it indicates that confirmation of PPP is more robust in high inflationary countries. Holmes (2001) along with high inflationary countries has also taken under the consideration of alliances of 30 emerging countries by geographic areas and by utilizing the IPS penal unit root test, he was unsuccessful in rejecting the unit roots hypothesis in countries having a high inflation rates.

It is stated that the rate of NER appreciation equals the rate of RER appreciation plus the surplus of foreign inflation above residential inflation. So there are two factors that contribute to strengthen a currency. (1) Trading partner's inflation rate is above the residential inflation rate. (2) Rise in the comparative worth of the nation's exports. So we can also define relative PPP as, the rate of appreciation of the NER equals the foreign inflation rate less the residential inflation rates. RPPP normally works well for high inflationary nations because in those nations, variations in the comparative inflation rates are normally much higher than the variations in RER.

From the time when there has been increasing tendency of financial modifications and trade liberalizations in the developing economies over the past decades, it is interested to examine whether the elimination of trade barriers and liberalization of the interest rate affect the movement in the exchange rate. Likewise, the rationality of the exchange rate models, for example, monetary methodology to exchange rate and monetary approach to exchange rate density significantly depends on the reality of the PPP state. The volatility in the exchange rate can be utilized as a tool to study the competitiveness of a nation in the world's trade. Additionally, exchange rate as a fundamental part in keeping parity in the balance of payments (BOP).

These implications provoke the attention of the researchers and policy representatives to study the performance of exchange rate. Since after 1980s, both trade liberalizations and financial modifications are under the great concern of the Pakistan's economic policy. During the last few decades, a number of progressive development including the elimination of economic sanctions, deterioration in the interest rate, and the trade enterprises changed the overall atmosphere and led to globalize and liberalize economy. Concerning the exchange rate systems, the substantial measures have been taken to implement the floating exchange rate system. Pakistan followed a fixed exchange rate policy till 1982 and after that it enforced a managed flexible exchange rate. Pakistan adopted a dualistic exchange rate system[1] in July 22, 1998, with the purpose to reduce the adverse effects of economic sanctions. In May 19, 1999, the dualistic exchange rate regime was substituted with dirty

[1] Under dualistic exchange rate system there are the existence of two exchange rates, the inter-bank flexible rate and the composite rate. Inter-bank flexible rate can be find out by the forces of market's supply and demand and the official exchange rate is determined by the state bank of Pakistan. Whereas, the composite rate was the weighted average of the inter-bank flexible rate and the official exchange rate.

floating (Managed floating) unitary exchange rate system. Nevertheless, the unified exchange rate regime was also substituted with flexible or free floating exchange rate system. Generally, the moderations in the forex exchange rate constraints, alteration in the exchange rate system and trade liberalization has increased the significance of exchange rate dynamics in Pakistan. Therefore, it is worthy to study whether exchange rates are finding out in the context of PPP or whether the RER series are stationary.

Current and previous studies have shown undistinguishable picture for the rejection of null hypothesis of unit root in RER series. Majority of those papers concluded that RER series are nonstationary and PPP theory does not exist in case of Pakistan against its trading partners. In their studies they utilized the standard Augmented Dickey Fuller (ADF) and KPSS (Kapetanios, Shin and Shell) unit root test. Standard ADF test does not considered structural breaks and nonlinearity, whereas KPSS only considered nonlinearity. So a test is required that considered both multiple temporary structural breaks and nonlinearity instantaneously. Then one has to check whether RER series are stationary or having deterministic trend. Therefore, we have chosen newly developed Fourier ADF (FADF) and Fourier KPSS (FKPSS) unit root tests for this task. The advantage of Fourier ADF and Fourier KPSS tests are that it measures structural breaks and nonlinearity simultaneously.

1.2 Objectives of the Study

The core intention of this study is to check whether real exchange rate series of Pakistan against its major trading partner's stationary when multiple structural breaks along with nonlinearity are considered simultaneously. If we found real exchange rate

series of Pakistan against its major trading partner's stationary than we will conclude that PPP theory holds, after considering the high power tests (FADF and FKPSS) that not only take into account of multiple structural brakes but also nonlinearity adjustment.

In this research study we will execute an empirical analysis of PPP theory which is one of the standard assumptions of long-run equilibrium in international macroeconomics models. Our focus will be on Pakistan's rupee-based PPP with its major twenty-one trading partners, i.e. Australia, Bangladesh, Belgium, Canada, China, France, Germany, India, Italy, Japan, Kuwait, Malaysia, Netherlands, Oman, Saudi Arabia, South Africa, Spain, Turkey, United Arab Emirates, United Kingdom and United States.

1.3 Significance of the Study

Previous studies have shown undistinguishable picture for the rejection of null of unit root in RER series. Majority of these papers concluded that RER series is nonstationary and PPP theory does not hold in case of Pakistan. Majority of those studies have utilized the standard ADF and KPSS unit root tests. Standard ADF test does not considered structural breaks and nonlinearity, whereas KPSS only considered nonlinearity. So a test is required that considered both the structural breaks and nonlinearity adjustments instantaneously. Than one has to check whether RER series are stationary or nonstationary. That's why we have chosen newly developed Fourier ADF and Fourier KPSS unit root tests for this task. The advantage of FADF and FKPSS tests is that it measures temporary structural breaks and nonlinearity adjustments simultaneously.

1.4 Strategy of the Study

The rest of the thesis is organized as follows: Chapter 2 deals with the review of literature. Chapter 3 describes the theoretical framework of the study. The econometric methodology along with data and its sources are discussed in Chapter 4. The empirical outcomes along with its discussion are discussed in chapter 5. Concluding remarks along with policy recommendations are given in chapter 6.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

In chapter 2 we present a literature review on the stationarity of RER series and validity of PPP theory. Two different beliefs exist in literature to assess the performance of exchange rate, one that rely on the naïve random walk model by Meese and Rogoff (1983) and other that believes in economic theories of exchange rate. In this chapter we review the observed studies that may be helpful in understanding the relationship of real exchange rate series between the trading partners and validity of PPP theory.

This chapter is organized in to three major sections. Section 2.2 comprises of the general empirical literature review on the debates of real exchange rate such as PPP theory. Section 2.3 deals with the empirical literature review on inappropriate econometrics techniques and lack of waste time span data that causes PPP theory invalid. Section 2.4 is devoted to the literature review on the validity of PPP in case of Pakistan.

2.2 Empirical Literature Review

The preliminary research work on the validity of PPP in advanced nations utilized standard ADF unit root test on the flexible exchange rate data and in majority cases they did not find any satisfactory confirmation for validity of PPP theory. A common justification why these researchers frequently unsuccessful in finding any confirmation in favor of PPP was due to not having the power of unit root tests, in comparatively small sample size. To account comparatively small sample complication, analysts use long perspective (more than 180 years) data of advanced

nations and illustrated stronger refusal of the null of unit root test. Nonetheless, data of the longer period comprises of fixed and flexible exchange rate regimes could not resolve whether validity of PPP would exist over a longer period of time under a stable exchange rate system.

To illustrate the lesser power unit root tests with the data that comprises of post-1973, researchers have twisted to panel approaches that permit for cross section disparities, as established by Lin, Levin and Chu (2002) and Pesaran, Im and Shin (2003). Generally, the observed evidence has been helpful for the existence of PPP theory. Although the earlier research work like, Jorion and Sweeney (1996) and Frankel and Rose (1996) found much solid provision for PPP, and some other studies that utilized integrating successive correlation in Papell (1997) and simultaneous correlation in O'Connell (1998) found weak evidence in favor of the validity of PPP. In more recent times, studies that utilized panel unit root tests and quarterly data of RER of post-1973 with the U.S. dollar as a base currency through 1997 or 1998 have tendency to deliver much robust provision of the rationality of PPP for advanced countries. Illustration of such research work comprise of Zakrajsek and Higgins (2000), Wu (2001) and Papell (2005). Theodoridis and Papell (2001) indicated slightly stronger refusal of the unit root hypothesis for the RER of European as compare with non-European currencies.

Support for the validity of PPP under a panel unit root test is not found in less advanced countries. By utilizing the real exchange rate (RER) and black market citations of NER data, Kassimatis and Phylaktis (1994) rejected the hypothesis of unit root for approximately eight Pacific Basin countries. Heston's (1991) and Oh (1996) utilized the Levin, Chu and Lin tests, but they were unsuccessful to reject the null of unit root in RER series of less advanced countries in the regime of floating exchange

rate. Holmes (2001) operated panel unit root tests, which was established by Pesaran, Shin and Im (2003), he was unsuccessful most of the cases to reject the null of unit root in panel of the countries that situated outside of the Africa and those that had having high inflation rates. Therefore, as panel techniques have meaningfully improved the unit root tests power still those research studies that incorporated these upgraded techniques failed to provide any convenient support in favor of PPP theory.

From the outcomes of previous literature review it is observed that there are substantial deviations from PPP theory over the short interval (Taylor, 2000; Shiller, 2013). Most of the empirical research works rejected the rationality of correlation between relative price level and exchange rate in the time span of a short run. Though, in the longer period, if exchange rates deviate from its equilibrium position, market forces might take them along to their PPP rates. However, investigations of the validity of PPP philosophy over a long period of time also produce irregularities that seem to be related in the under considered currencies, price indexes are used for the estimation of inflation, level of prices, and observations that is under deliberation (Shiller,2013).

There are number of complications regarding the generation of PPP model, that is functional for the time series data which has been sampled below the Nyquist-Shannon sampling frequency (Taylor, 2000; Wang and Jones, 2002). Number of difficulties rises regarding temporal aggregation when data is sampled monthly or annually (Taylor, 2000). Small sampling observations could not possibly justify high sampling observations adjustment for parity condition (Taylor, 2000; Jones and Wang, 2002). In spite of the fact that few empirical research works are in favor of the validity of PPP philosophy but majority of the latest research works do not provide any satisfactory evidence. The research work that supported the PPP theory included;

Cassel (1916), Keynes (1923), Frankel (1978), and Ohno (1990); all of them established positive evidence for PPP theory. On the other hand, the outcomes of Friedman et al., (1963), Hakkio (1984), Mark (1990), and Rogoff (1996) are not supportive for the theory of PPP.

Moosa and Bhatti in their book, Theory, Econometric Testing and Empirical Evidence, analyzed the hypothesis of PPP theory, which assumes a relationship between prices and exchanges (Chapter No. 2). They argued that PPP theory can also be classified in accordance with the degree of three types of restrictions, i.e. the univariate, the bivariate, and the multivariate models. The univariate type of model is tested against the restrictions that representing the properties of symmetry and relation to originate an appearance for the real exchange rate. This description suggested that cointegration between the relative prices and nominal exchange rate is a compulsory but not a satisfactory condition for the long run theory of PPP to hold. The satisfactory condition is that there must be one-to-one correspondence between the relative prices and nominal exchange rate. Under such circumstances, empirical testing must be concerned with the property of mean reversion in the real exchange rate. Therefore, it is the real exchange rate, not the error terms of the unrestricted cointegrating vector, that is tested for unit root (Chapter No. 9). In addition to that they also tested the empirical rationality of PPP theory for a large number of currencies under both flexible and fixed exchange rates. For the determination of that analysts have employed various methods for its estimation, numerous diversified models specifications and simple data is utilized with fluctuating frequencies and time prospects (chapter No. 10).

In one of their other book, the theory and empirics of exchange rates, Moosa and Bhatti argued that, with respect to exchange rate regime choice, almost all countries

do not necessarily exercise what they acknowledged. It is in the interest of country, to do not mention the exchange rate regime. China is the most recent example of assuming a crawling peg exchange rate regime but she declared another one i.e. basket peg exchange rate regime. Moosa and Bhatti (2008) put some effort to analyze the China exchange rate regime that has been succeeding since 21 July 2005 when a policy shift was applied, probably taking China from a dollar peg to a basket peg exchange rate regime. The outcomes show that while the preceding exchange rate regime of simple and strict dollar peg has certainly been abandoned, the analyze evidences does not support the proposal that the current prevailing exchange rate regime is a basket peg exchange rate regime. The suggestion on the based empirical findings is that, the current Chinese exchange rate regime is some kind of a flexible crawling peg against the U.S. dollar. It is further argued that this king of exchange rate regime is consistent with the objectives of the Chinese government, in preserving a competitive advantage while avoiding a trade-war with its trading partner (i.e. U.S). Moosa and Bhatti concluded that a crawling peg exchange rate model is more influential in forecasting the exchange rate of yuan and dollar than a basket peg exchange rate model.

Some of the most important reasons due to which PPP theory failed to hold, comprise of unalike economic circumstances of the nations where parity was actually examined, dissimilar economic strategies, differential in the level of prices for non-traded commodities in poor and rich countries, economies real stocks, fluctuations in the prices between domestic and international markets and last but not the least dissimilarities in the time span on which the research works were finalized.

2.3 Empirical Literature Review on Inappropriate Econometric Techniques and Lack of Waste Time Span Data, Causes PPP Theory Invalid

Serletis and Hrine (2010) indicated that although most of the initial studies failed to verify the validity of PPP philosophy and later research works engaged econometric practices to estimate and fine-tune previous testing techniques to remove faults in the initial estimation practices. They also find that PPP assessment methodology evolved over time span and under this classification design there overlapping in various time spans in which research works took place. Time period is an essential on which a research work is taken place because there are many economic variables that are precise to terrestrial position or those may be associated to occasion and thus dependent temporary on that time period.

Enders (1988) utilized ARIMA test, which brings about miscellaneous provision for the hypothesis of PPP over the Bretton Woods time span and the floating exchange rate regime. The point assessments did not significantly vary from unity even if we estimate long period RER for Germany, Canada, and Japan. The estimation techniques used for these three countries show that the RERs come together over the longer period of time. Though, the null of unit root may not be rejected because confidence intervals were sufficiently large. The co-integrated tests too delivered miscellaneous indication for the validity of PPP. However, there was solid provision for cointegration of Japan and US price level after 1973 but still the estimation for a longer period of time is far from unity. This suggested that the models of error correction are in harmony with the in-built impression that prices of the US will regulate to any abnormality from PPP theory. Other than a decline in the forecast ability and intensification in the variability of real exchange rates, there is still minute provision to state that PPP philosophy was distorted for the period of 1970s.

The tests for evaluating stationary and the point estimates emphasized that PPP behaves by the same token well or poor over both time span. By assessing time series data after the termination of the Bretton-Woods Agreement (Rogoff, Meese, 1988; and Mark, 1990) concluded that there is no supported evidence for the rationality of PPP philosophy. Frenkel (1986, 1990) comes with the possible reason for the lake of supported evidence for PPP theory. He mentioned that the method used for the conduction of that research work did not involve adequate time interval, and the data collected had unsatisfactory data points to indicate both signal of deviation along with adherence to the theory of PPP. He also recommended following two methodologies that would raise the power of the tests: (1) use time series data as long as possible and (2) acquired flexible exchange rate data for a panel of nations. Jorion and Abuaf (1990) show support for the utilization of very long period time series data; they argued that studies might be beneficial by utilizing very long time series data (i.e. 100 years). The utilization of a very long time span series data has produced strong support for PPP theory.

Rose and Frankel (1996) and Papell (1997) have established strong supportive evidence for validity of PPP theory by means of panel examination involving many nations. Conversely, the research work of O'Connell (1998) found that the confirmation for the validity of PPP theory utilizing the panel technique vanishes if someone considers the robust cross sectional reliance in RERs. If someone takes into account of univariate exchange rate, then this argument does not relate for that. Klassan (1999) has established supportive evidence for the long run relationship of relative PPP for flexible exchange rate regime. He utilized new test for obtaining supportive evidence of PPP containing a Regime-Switching model in which Regime-Switching probabilities were subject to the exchange rates departure from PPP. Up till

now, the literature delivers no clear supportive evidence concerning the long run rationality of PPP theory.

2.4 Literature Review on the Stationarity of RER and PPP in Pakistan

A number of studies have been conducted to examine the validity of PPP not only in the Asian countries (especially Pakistan and developing countries) but also around the world. Most of the current and previous studies could not find any significant evidence in favor of PPP theory (i.e., stationarity of RER series). In those studies, several newly developed and old techniques of unit root tests were applied but failed to reject the null of unit root (i.e., nonstationary) in the RER series. PPP is considered as a backbone of many macroeconomics models and its rationality has significant policy implications. Previous studies of purchasing power parity are dependent on linear unit root test, whereas modern work account for nonlinearity and structure breaks in RERs. Conversely, the dispute on the rationality of PPP is unsettled.

Moosa and Bhatti (1994) presented empirical evidence on long run Purchasing Power Parity (PPP) theory. For that they utilized annual data which extended from the time period of 1900 to 1987. They utilized the exchange rates of three currencies against the pound in their analysis and the currencies were, French franc, Chines Yen, and U.S. dollar. In their analysis the results of proportionality and symmetry restrictions are shown that PPP theory does hold in the long run. The outcomes of the Error-Correction models indicated that there is considerable short run deviation from PPP theory which take around two to three years for its adjustment.

Bhatti and Moosa (1994) hypothesized that conventional PPP theory disregards the role of uncertainty and expectations in the determination of exchange rates. They argued that, in the existence of uncertainty and expectations about the future, as assumed by ex-ante PPP theory, the exchange rate is determined not only by the current relative prices but also by the expected real exchange rate. This indicated that the omission of the anticipated real exchange rate makes the model of PPP theory misspecified. Empirical testing results show the significant role played by the anticipated real exchange rate in determining the existing nominal exchange rate. All these findings show support for the ex-ante model of PPP against the model of conventional PPP theory.

Moosa and Bhatti (1994) presents some empirical findings on the traditional covered interest rate parity theory and the modern forward exchange rate theory under the current regime of floating exchange rates. They claimed that reintegration analysis is more suitable for testing these theories and that it is inaccurate to test the restriction disguised by these theories on the basis of the conventional standard errors and t-statistics. One specification of the traditional covered interest rate parity theory and two specifications of the modern forward exchange rate theory are estimated by using an expectations construction mechanism that is a superior case of the rational expectations. The outcomes favor the traditional covered interest rate parity theory, giving approximately all weight to arbitrage and giving almost zero weight to speculation in the forward exchange rate determination. These findings are consistent with the intention that financial deregulation, elimination of capital controls and the integration of financial markets have formed perfect atmosphere for the operation of covered interest rate parity theory.

Bhatti (1996) in his paper analyzed the corrected test for testing the validity of Purchases power parity (PPP). He utilized quarterly from $1982Q_1$ to $1994Q_4$. In his paper he presented some observed evidence on the long run PPP for eight Pak-rupee exchange rates over the time period of thirteen years. For testing cointegration and coefficient restriction he utilized the Johansen test and the results obtained from that shows support in almost all the cases. He also verified the mean-reversion in the real exchange rates by utilizing the Sim and Bayesian test and the outcomes obtained from that test are also supportive. In conclusion he added that the devaluation of Pak-rupee against the major industrial currencies improbable to encourage the cross border competitiveness and as a result of that there is a deficit in country's trade.

Bhatti (1997) in one of his paper presented the role of expectations in the determination of Pak-rupee exchange rate against the major following three currencies i.e. dollar, pound, and yen over the time period of almost 12 years. For that study he utilized the monthly data that extended from 1982_1 to 1993_7. For that study he used the cointegration and coefficient restriction tests. The outcomes of these tests in two out of three cases are in favor of the view that exchange rate determination in hypothesizing that in efficient markets in which uncertainty and expectations about the future are dominant, the equilibrium nominal exchange rate is determined not only by the current comparative prices but also by the anticipated real exchange rates. The outcomes also suggested that the real exchange rate series are not stationary, that means that the results are supporting the ex-ante PPP theory. In conclusion, he marked that the anticipation inflation rate in Pakistan is much higher than the other partner's countries, which have a tendency to encourage the native inhabitants to translate their current balance into foreign currencies, with the intention of

deteriorating the term of trade and offsetting the gains of the continuous devaluation of Pak-rupee by the discouragement of external competitiveness.

Moosa and Bhatti (1999) presented the proposition of Gustave Cassel, the originator of the PPP theory. They stated that the theory of PPP has been misunderstood and the PPP theory proposed by Gustave Cassel is not the theory that is described in the contemporary literature. It was claimed that this misunderstanding has led to numerous drawbacks, including the un-meaningful distinction between relative and absolute PPP theory, and also observing the PPP theory under the affiliation of arbitrage. It was concluded that Gustave Cassel presented an operational theory in which exchange rate is influenced by monetary and non-monetary factors but Gustave Cassel PPP theory is described as an automatic adjustment between the level of price and the price ratio. It was also argued that the Gustave Cassel proposed the difference between relative and absolute PPP theory, however there was no such kind of division in his writing. It was also added that Gustave Cassel theory of PPP was actually the extension of the quantity theory of money (QTM) in case of open economy but unfortunately it was taken under the concept of an arbitrage. The drawbacks of these misunderstandings are, the difference between relative and absolute PPP theory is terminated for the determination of empirical testing because price indices are consistently used for this purpose. Testing the PPP theory under the context of first difference is defective because if PPP theory is valid than first difference model is miss-pacified, and for the reason that satisfactory outcomes recommend the failure of PPP theory.

Bhatti (2000) collected quarterly data of exchange rate of Pak-rupee vs U.S. dollar for the period of $1984Q_1$-$1998Q_4$. In the study he employed Johansen Maximum Likelihood technique of co-integration and coefficient restrictions tests. In the

conclusion remarks he penned that co-integration and coefficient restrictions tests obtained by using the Johansen technique are strongly helpful for PPP in five out of eight cases, whereas the Engle-Granger and Phillips-Ouliaris residual-based co-integration tests are not.

Doganlar and Ozmen (2000) collected the quarterly data from the period of $1986Q_1$-$1997Q_4$ for 18 developing countries. They utilized ADF and PP unit root tests to check the stationarity of the real exchange rates. Both ADF and PP tests had shown the presence of unit root (nonstationary) for under considered developing countries. They concluded that the presence of PPP theory does not exists for under considered developing countries.

Bhatti (2001) in one of his paper determines the Pak-rupee exchange rates regarding six currencies of the industrial world. For that study he utilized the quarterly data of nineteen years. The empirical rationality of the Mubdell-Fleming model is examined of Pak-rupee exchange rates regarding the currencies of the six industrial world and the data used for that study is extended from $1982Q_1$ to $2000Q_4$. The multivariate maximum likelihood method of cointegration is tested which was developed by Johansen and Jusilius, to estimate a long run relationship amongst the nonstationary variables. The outcomes of that test are shown support for the model in almost all the cases except two, i.e. Pak-rupee exchange rates against the French franc and the U.S. dollar when the data on long term interest rates were used instead of the data on short term interest rates were used. In conclusion he added that Pak-rupee exchange rates against the industrial world currencies are determined by the differences in prices, income, and interest rates. This indicated that if the monetary representatives wanted to strengthen the currency of Pakistan against the underlined industrial world currencies than they must adopt the strategies that aimed to lowering

the prices and real growth and levitating the interest rates comparative to pre-mentioned industrial countries.

Moosa and Bhatti (2006) studded the effect of the nominal exchange rate regime on the volatility of real exchange. In this paper they tried to test the hypothesis that real exchange rates are more unstable under flexible than under the regime of fixed exchange rates. They utilized five numerical procedures of nominal exchange rate flexibility to avoid the problem of distinguishing between de facto and de jure exchange rate regimes. The outcomes indicated that for OECD countries the nominal exchange rate regime does matter, but they failed to accept the existence of PPP theory. Although, the outcomes also show that the volatility of real exchange rates are affected by some variables which are missing.

Mohsen, Ali and Su Zhou (April 2008) study the RER nonlinear mean reverting process in developing nations. They collected monthly data of real effective exchange rates (REER) from 88 developing nations and tested the unit root by means of ADF and newly developed test KPSS. When they related the results together of both tests they found that the KPSS test supported the purchasing power parity (PPP) theory in twice as many developing countries as previous ADF test did. This outcome recommended that nonlinear adjusted towards PPP in developing countries is crucial phenomenon. The outcomes of stated countries indicated that PPP holds more frequently in those countries in which there are high inflation and high fluctuated exchange rates.

Arshad and Qayyum (2008) utilized the approach that was originated by Pesaran and Shin to test the Symmetry and proportionality assumptions of the PPP theory. They examined the validity of unrestricted versions of PPP for Pakistan utilizing the

quarterly data for the time duration of $1982Q_2$-$2005Q_4$, under the context of multivariate co-integration and Vector error-correction modeling approach. Their study supported the validity of PPP theory in weak form. Moreover, the symmetry and proportionality assumptions of PPP were not confirmed. In the short-run, foreign prices and exchange rate play prominent role in the convergence process in order to get the long run equilibrium, though the speed of correction is very slow.

Bhatti and Moosa (2010) studied the theory and empirics of exchange rates and stated that in early 1990s, when the U.S. put off the convertibility of the dollar into gold since than the exchange rates and their particularities have been getting increasing attention. In this widespread referenced volume, R.H. Bhatti (Gulf U. for science and technology, Kuwait) and I. Moosa (Monash U., Australia) presented the comprehensive explanation under diagrammatic and mathematical models of the determination of exchange rates and the balance of payments (BoP). They discourse the empirical indication for the failure of macroeconomic models for the determination of exchange rates and reasons for its failure. They recommended that mainstream macroeconomics economists must incorporate substitute methods for the determination of exchange rates.

Noman and Rahman (2010) inspected the stationarity of south Asian RER. They assembled monthly data from Feb.1973 to Jun.2007 for every single country. They focused their study on the major four countries of south Asian, i.e. Bangladesh, India, Pakistan, and Sri Lanka. They utilized ADF and KPSS tests in their study. The results of ADF show that one cannot reject the null of nonstationary in all cases and on the other hand KPSS test results also reject the null of stationarity in majority of cases. Both tests result showed that south Asian countries real exchange rates (RER) are unit

root (i.e., nonstationary) and having no long-run mean reversion process to words equilibrium.

Bhatti and Moosa (2012) analyzed that whether conventional or ex-ante PPP holds for the exchange rates of the three CIS currencies. For that he utilized the monthly data from $1995m_1$ to $2010m_6$. For testing the cointegration he used the Engle and Granger and Phillips and Ouliaris tests. He also tested the coefficient restriction test based on the West. The outcomes from these test suggested that the real exchange rates from these currencies are not stationary. That's why he concluded that PPP theory does not hold even in the long run.

Ariful and Rajabrata (2014) checked the stability of real exchange rate of south Asian countries by considering the structural breaks. They collected monthly data of NER, CPI, and PPI (producer price index) from the period of 1957 to 2011 (55 years). They applied ADF, PP and KPSS unit root tests, by permitting both single and multiple endogenous structural breaks for all four countries, i.e. Bangladesh, India, Pakistan, and Sri Lanka. For majority of south Asian countries, without structural break consideration shown concrete picture of RER stationarity. In the meantime, both single and multiple endogenous structure break unit root tests intensely recommended that RER of Pakistan, Sri Lanka, Bangladesh, and India are indistinguishable from the integrated of order one, i.e., I(1) process. This outcome indicated that PPP theory doesn't exist for the south Asian countries.

Current and previous studies have shown undistinguishable picture for the rejection of null of unit root in RER series. Majority of those papers concluded that RER series is nonstationary and PPP does not hold in case of Pakistan. In their studies they utilized the standard ADF and KPSS unit root tests. Standard ADF test does not

considered structural breaks and nonlinearity, whereas KPSS only considered nonlinearity. So a test is required that considered both the multiple structural breaks and nonlinearity adjustments instantaneously. Than one has to check whether RER series are stationary or nonstationary (i.e. PPP based on RER holds or not in case of Pakistan against its major trading partners). That is why we have chosen newly developed Fourier ADF (FADF) and Fourier KPSS (FKPSS) unit root tests for this task. The advantage of FADF and FKPSS tests are that it measures temporary structural breaks and nonlinearity adjustments simultaneously.

CHAPTER 3

THEORETICAL FRAMEWORK

3.1. Introduction

Theoretically, there are many factors that affect the long-run validity of PPP theory. PPP theory may vary steadily with features of the countries and the reasons behind that are; countries having a free flow of trade may hold better for PPP because trade hurdles get in the way of international arbitrage and amongst nations that are geographically nearer, for the reason that extraordinary transportation expenses related with larger remote areas might hurdle trade and arbitrage. Countries having a similar inflation rates may cause PPP to hold because countries having a different inflation rates might avoid their NERs from adjustment to parity. In advanced countries, PPP might hold better amongst countries with comparatively low NER fluctuations because stringencies may avoid prices from adjusting to parity. On the other hand, in emerging nations, with low NER fluctuations might indicate limitations on exchange rate volatility that avoid PPP from griping. To end with, Samuelson (1964) and Balassa (1964) postulated that RERs appreciate in those countries that have high productivity growth in traded goods. Therefore, PPP would not hold between countries that have low growth and high growth rates.

This chapter evaluates the theoretical framework associated with the stationarity of RERs and PPP theory. The discussion is prearranged in to three major sections. Section 3.2 deals with the theory of law of one price (LOP). Section 3.3 comprises of the PPP hypothesis, including both the absolute PPP and relative PPP. Section 3.4 is devoted to the real exchange rate hypothesis.

3.2 Law of One Price

The philosophy of LOP was first of all spread out in the 16th century, but Karl Gustav Cassel (1921) was most attributed with his work on growth of PPP. After the breakdown of the gold standard regime, his work on exchange rates shaped the fundamental idea behind the theory that exists today. The LOP theory forms the basis of the PPP hypothesis. The LOP theory states that indistinguishable commodities in different nations should trade at the same price once transformed into a common currency. The responsible factor behind the process that converge the price to parity condition amongst the nations is arbitrage. Arbitrage is the procedure of purchasing and selling the commodities in order to exploit a price disparity so as to make profit without considering any risk. Once the process of arbitrage starts, it remains up until prices have congregated to the degree that the possibility of more profit is vanished.

Philosophy of LOP can applied on both with in a country as well as cross border setting; that is essential to transform it into a common currency. The philosophy of LOP does up to some extent abstract from authenticity, since in reality prices are affected once it crossing the border. At present, there are still abundant features of cross-border trade that have an influence on country explicit prices. Tariffs, non-tariff obstacles and transportation cost effect prices and first two misrepresent the prices that are paid for the traded commodities. Whenever we are working on the cross-border prices these distortions need to be account. The key principle however will remain there that are price parity must take place through arbitrage and through free flow of trade.

3.3 Purchasing Power Parity Hypotheses

The PPP hypothesis postulates that the RER is stationary so that the NER and domestic and foreign price levels of goods and services converge to the long-run

equilibrium over period of time. When all nations produce same commodity or same basket of commodities and those commodities are traded without any restrictions among the nations under such situation, no one will trade residential commodities for foreign commodities with the exception of one to one basis (not to considered transportation cost). In this case, the RER would always equal to one. The RER is the number foreign commodities that can be acquired in interchange for one unit of residential commodity. Actually every nation produces thousands of unlike commodities, that's why RER must be based upon the price index (i.e., CPI) to measure domestic and foreign prices variations in the RER with a period of time indicating that, on average, commodities of the nation whose RER is appreciating are becoming more expensive relative to the commodities of the other nations. The notion that similar foreign and residential commodities or set of commodities should have the same worth in terms of the same currency is known as PPP theory.

Purchasing power parity has following two types:

3.3.1 Absolute Purchasing Power Parity

The absolute PPP refers to the equalization of level of prices across the trading partner countries. The idea was resulted from a basic concept of the LOP, which stated that the real price of a commodity must be identical across all the trading partners. If we take the weighted averages of prices for all the commodities within the trading partners, absolute PPP preserves that the currency exchange rate between two nations must be alike to the ratio of the level of prices of both the trading partners. The emphasize circumstances should be met for absolute PPP if one as to hold: 1. Commodities between the trading partners must be freely traded in the international markets. 2. Price index of the same basket of commodities must be considered for each trading partners. 3. Same year prices of all the commodities needs to index.

3.3.2 Relative Purchasing Power Parity

The relative PPP is associated to the transformation in the two trading partners predicted inflation rates to the alteration in their exchange rates. Inflation diminishes the real purchasing power of the trading partner's currency. Relative PPP examines the comparative variations in level of prices between two trading partners and preserves that exchange rates will transform to compensate for inflation disparities.

If the absolute PPP held then relative PPP will also hold, but when the relative PPP holds than the absolute PPP may not hold. It is due to the existence of capital movements among countries, transportation cost, and other obstacles to the free flow of international trade. The administration interventional policies lead to the refusal of absolute PPP and only a change in these lead the relative PPP theory off track.

3.4 Real Exchange Rate Hypothesis

The RER is the ratio of the overseas and the domestic level of prices, where the overseas level of price is transformed into home currency units through the current nominal exchange rate (NER). The RER states that how many times in approximation goods and services can be acquired in a foreign country (after translation into a foreign currency) than in the native marketplace for particular amounts. In reality, variations of the RER are more important than its absolute level. As compare with the NER, the RER is always "fluctuating", even the time when there is a fixed nominal exchange rate regime, the RER can move through changes in the level of price. Instead of concentrating on the NER it is more practical to monitor the RER when evaluating the effect of exchange rates on the export competitiveness of a nation.

Current debates on the macro-economic policy in both the developed and developing nations have given emphasis to the central role played by the RER in the regulation progression. There is emerging agreement that constant RER misplacement will regularly create severe macro-economic dis-equilibria, and that the current account deficits (CAD) will normally have need of both the demand controlling policies and RER devaluation. Likewise, in latest policy assessments of the performance of the less established nations it has been claimed that more effective emerging nations attained their achievement to maintain the RER at its suitable level. So, it is not an overemphasis to claim that RER performance conquers a dominant role in designing policy and its evaluation.

The discussion on the subject of the role of the RER in designing policy (Montiel and Hinckle, 1999) and long-run growth and macro-economic policy occupies a central position in economic research work (Lane, 2001). The RER is an economic widespread relative price that has been associated to fundamental macro-economic phenomena. Constant overvaluation has been associated with lower long term economic growth (Calderon and Aguirre, 2006), subordinate financial deepening (Dehesa et al., 2007), and higher inclination to currency crisis (Coudert and Burkart, 2002). Nations that have evaded insistent overvaluation, in contrast, have been linked with overseas trade deepening and export divergence (Dollae, 1992; Elbadawi, 2002). The RER unpredictability has also been established to affect negatively macro-economic performance, in specific long term economic growth (Loayza and Hnatskova, 2004), long-run output growth (Aghion et al. 2006), and private investment (Serven, 2003).

CHAPTER 4

ECONOMETRIC METHODOLOGY

4.1. Introduction

In this chapter we have explored the econometric methodology issues by taking the Fourier unit root model to find whether the RER series are stationary or not and purchasing power parity in case of Pak-rupee against its major trading partner countries hold or not.

This chapter comprises of econometric methodology and its specification. The discussion is arranged in three main sections. Section 4.2 of this chapter deals the data and its sources. Section 4.3 explains unit root tests which include standard ADF, Fourier ADF (FADF), standard KPSS, and Fourier KPSS (FKPSS) unit root tests. Session 4.4 of this chapter deals with the procedure of estimating the Fourier unit root model.

4.2 Data and its Sources

For the analysis of this study, secondary data has been used. Stationarity of RER of Pakistan has been tested and for this purpose quarterly data of different variables are collected for the period 1990 to 2014. The variables that we have used in our estimations are NER, CPI, and WPI. The exchange rates of Pakistan against its major twenty-one (21) trading partners are selected on the basis of Pakistan total trade (exports and Imports).

In this research study we analyzed real exchange rates of major 21 trading partners of Pakistan, i.e., Australia, Bangladesh, Belgium, Canada, China, France, Germany, India, Italy, Japan, Kuwait, Malaysia, Netherlands, Oman, Saudi Arabia, South Africa, Spain, Turkey, United Arab Emirates, United Kingdom, and United

States. Data of NERs, CPI, and WPI are collected from World Development Indicators (WDI) databank, IMF's International Financial Statistics (IFS), and IMF's Direction of trade.

RER is calculated as:

$$RER_t = NER_t(WPI^*{}_t/CPI_t) \tag{1}$$

Where NER_t is define in home currency per unit of foreign currency; RER_t stands for real exchange rate; $WPI^*{}_t$ represents whole sale price index of foreign country, and CPI_t stands for consumer price index of domestic country (i.e. Pakistan). After taking the natural log of equation (1), we get;

$$\log RER_t = \log NER_t + \log WPI^*{}_t - \log CPI_t \tag{2}$$

4.3 The Model

In order to realize the stationarity of real exchange rate series of Pak-rupee against its major trading partners we practiced newly developed FADF and FKPSS unit root tests by Enders and Lee (2012), and Becker et al. (2006) respectively. They incorporated the trigonometric variables to capture the large variations in the mean of y_t.

4.3.1 Augmented Dickey-Fuller (ADF) Test

The standard linear ADF unit root test by Dickey-Fuller can be expressed as:

$$\Delta y_t = c_0 + \rho y_{t-1} + \sum_{i=1}^{l} c_i \Delta y_{t-i} + e_t \tag{3}$$

Here y_t is the time series of interest, coefficients ρ and c have to be estimated, lag length for the lagged values of Δy_t is denoted by l, and e_t is the residual term. Null of unit root ($H_o: \rho = 0$) is tested against the alternative of stationarity ($H_o: \rho < 0$). If null is accepted than y_t will be treated as a non-stationary series. The null hypothesis is tested by using $\tau - test$, which is calculate as follows;

$$\tau_{DF} = \frac{\hat{\rho}}{se(\hat{\rho})} \tag{4}$$

where τ_{DF} is Dickey-Fuller $\tau - test$, $\hat{\rho}$ is estimated value of ρ and $se(\hat{\rho})$ is standard error of $\hat{\rho}$. This test is a one sided test because the alternative hypothesis is $\rho < 0$.

4.3.2 Fourier ADF (FADF) Test

Fourier ADF unit root test is developed by Enders and Lee (2012), they recommended that FADF approximation can account for both unattended nonlinearity and unidentified multiple structural breaks of the model. Enders and Lee simply modified the ADF unit root test in which deterministic component is a time dependent function denoted by $d_{(t)}$ i.e.

$$\Delta y_t = d_{(t)} + c_0 + \rho y_{t-1} + \sum_{i=1}^{l} c_i \Delta y_{t-i} + e_t$$

(5)

where e_t is a stationary residual term with variance σ^2 and $d_{(t)}$ is a deterministic function of t. It accounts for both unknown functional form as well as unknown number of structure breaks. Let $d(t)$ denotes a function with an unknown multiple number of structure breaks and unknown form of the variables;

$$d(t) = \alpha_0 + \sum_{k=1}^{n} a_k \, sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^{n} b_k \, cos\left(\frac{2\pi kt}{T}\right); \qquad n < \frac{T}{2}$$

(6)

where k represents the selected frequency for the estimation of Fourier series and n is the number of frequencies. t stands for trend term, T represents the number of observations, and $\pi = 3.1416$. We start with $n = 1$, when $n = T/2$ is reached, the fit of $d(t)$ will be perfect. We begin with by taking into consideration a Fourier approximation by using a single frequency, with the intention that;

$$d(t) \cong \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right)$$

(7)

The nonlinear Fourier ADF unit root test statistic (τ_{DF}) can be calculated from the following equation:

$$\Delta y_t = \rho y_{t-1} + c_o + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \sum_{i=1}^{l} c_i \Delta y_{t-i} + e_t$$

(8)

where γ_1 and γ_2 are the parameters for the Fourier approximation and measures the height and width of the frequency component. Again the null hypothesis is $\rho = 0$. When the form of $d(t)$ is unknown, any test for $\rho = 0$ is problematic if $d_{(t)}$ is mis-specified. The critical values for the null of a unit root will depend on the frequency k and the sample size T.

The ADF test is a unique case of the FADF test in which the trigonometric terms are set as zero (i.e. $\gamma_1 = \gamma_2 = 0$). If coefficients of trigonometric terms are equal to zero i.e. $\gamma_1 = \gamma_2 = 0$ then ADF unit root test is suitable. Conversely, if there are multiple structural breaks or nonlinear trend, as a minimum of one frequency must be considered in the data generating process. According to Enders and Lee (2012), the standard F-statistics can be utilized to test whether the trigonometric terms should be incorporated into the model. Under the null hypothesis of linearity, the F-statistics can be computed as:

$$F(k) = \frac{(SSR_0 - SSR_1(k))/q}{SSR_1(k)/(T-r)} \tag{9}$$

where $SSR_1(k)$ stands for sum of squared of residuals (SSR) from equation (8), q represents the number of restrictions, SSR_0 denotes the sum of squared of residuals from y_t the regression without the trigonometric terms and r represents the number of regressors in the regression.

Equation (9) indicates that the FADF test statistics depend on the frequency (k) and the lag length (l). Enders and Lee (2012) suggest that a Fourier function with k = 1 or k = 2 can serve as a rational approximation to capture multiple types of unknown structural breaks and k = 2 was estimated as a maximum frequency (k_{max})

for our study. The most favorable frequency $(\tilde{k})$ was chosen by data driven process (DDP) and the selected frequency will generate the smallest SSR among the different specifications in equation (8).

The best possible lag length $(\tilde{l})$ was chosen by means of the Akaike Information Criterion (AIC). The most favorable leg length is a selected lag length that generates the smallest AIC value among the different selection of lag length. The AIC can be estimated as:

$$AIC = -2\left(L/T\right) + 2\left(k/T\right) \tag{10}$$

where L is the log likelihood value which can be calculated as:

$$L = -\frac{T}{2}\left\{1 + In(2\pi) + In\left(\frac{\hat{\varepsilon}\hat{\varepsilon}}{T}\right)\right\} \tag{11}$$

where $\hat{\varepsilon}$ and $\hat{\varepsilon}$ are the estimated error terms from equation (8). To pick the lag length, there is requirement of specification of the upper bound or the maximum lag length(l_{max}). Hayashi (2000) has recommended utilizing the underlined equation:

$$l_{max} = int\left(\frac{T}{3}\right)^{*}\left(\frac{T}{100}\right)^{\frac{1}{4}} \tag{12}$$

where "int" is the integer function that surrounding a real number down to the nearby integer.

4.3.3 Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test

Kwiatkowski-Phillips-Schmidt-Shin (1992) developed a test to check the stationarity of the variables in time series data. In KPSS test a series say y_t is decomposed into sum of deterministic trend, a random walk, and a stationary residual term: The basic model to test for stationarity of the time series y_t used by KPSS is

$$y_t = \beta t + r_t + \epsilon_t \tag{13}$$

where r_t is a random walk

$$r_t = r_{t-1} + \mu_t \tag{14}$$

where the μ_t are $iid(0, \sigma_\mu^2)$. The initial value r_0 is treated as fixed and serves the role of an intercept. The stationary hypothesis is simply $\sigma_\mu^2 = 0$. Since ϵ_t is assumed to be stationary, under the null hypothesis y_t is trend stationary. If $\beta = 0$ then under the null hypothesis y_t is stationary around a level (r_0) rather than around a trend.

Let $\hat{e}_t,\ t = 1,2,\dots,T$, be the residuals from the regression of y_t on an intercept and trend term $(y_t = \alpha + \beta t + e_t)$. Let $\hat{\sigma}^2$ be the estimate of the error variance from this regression. The LM statistic (one sided) for the null hypothesis of trend stationarity can be calculated as;

$$LM = \frac{1}{T^2}\frac{\sum_{t=1}^{T}\hat{S}_t^2}{\hat{\sigma}^2} \tag{15}$$

where $\hat{S}_t = \sum_{i=1}^{t} \hat{e}_i$. Further, to test the null of level stationary instead of trend stationary, simply define e_t as the residual from the regression of y_t on an intercept only ($y_t = \alpha + e_t$) and then calculate LM test as above.

4.3.4 Fourier KPSS (FKPSS) Test

Fourier KPSS unit root test is developed by Becker, Enders, and Lee (2006). They suggest that Fourier type of unit root test not only account for multiple smooth temporary structural breaks but also for the nonlinearity adjustment. They modified the KPSS unit root test by allowing the time varying intercept under the null hypothesis. The modified equation is;

$$y_t = \beta t + d(t) + r_t + \epsilon_t \tag{16}$$

And,

$$r_t = r_{t-1} + \mu_t \tag{17}$$

Let $\hat{e}_t,\ t = 1,2, \ldots, T$, be the residuals from the regression of y_t on an intercept, trend term and trigonometric terms i.e.

$$y_t = \alpha + \beta t + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 cos\left(\frac{2\pi kt}{T}\right) + e_t \tag{18}$$

Let $\hat{\sigma}^2$ be the estimate of the residual variance from this regression. The LM statistic (one-sided) for the trend stationarity hypothesis is calculated as;

$$LM = \frac{1}{T^2}\frac{\sum_{t=1}^{T}\hat{S}_t^2}{\hat{\sigma}^2}$$

(19)

where $\hat{S}_t = \sum_{i=1}^{t}\hat{e}_i$. Further, to test the null of level stationary instead of trend stationary, simply define e_t as the residual from the regression of y_t on an intercept and trigonometric terms only i.e.

$$y_t = \alpha + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 cos\left(\frac{2\pi kt}{T}\right) + e_t$$

(20)

and then calculate LM test as above.

If the nonlinear trend does not exist it is possible to achieve increased power by means of the KPSS test. Thus, it becomes desirable to test for the nonexistence of a nonlinear trend (i.e. $\gamma_1 = \gamma_2 = 0$). We can test this hypothesis again by using F-test described in equation (9). It is crucial to note that the F-test can reveal unjustified power if the data are non-stationary. Therefore, F-test has the constraint that rejection of the null hypothesis of linearity does not necessarily mean that presence of the nonlinear trend. For that reason, F-test would be only utilized when the null of stationarity is accepted.

4.4 Procedure to Estimate the Fourier Type Tests

There are three steps procedure to compute the Fourier ADF and Fourier KPSS unit root tests.

Step # 1:

In the first step of analysis linear unit root tests can be utilized to examine the stationary process in the RER series.

Step # 2:

In second step we have to determine the optimal frequency ($\tilde{k}$) and optimal lag length ($\tilde{l}$). The optimal frequency is chosen by utilizing the SSR from equation (8) and (20), and the optimal leg length is selected by utilizing the AIC criteria. When frequency and lag length are chosen, the F-test can be used to examine whether the trigonometric terms should be include in the model. If the null hypothesis of linearity is rejected by F-test, a nonlinear FADF and FKPSS tests would be suitable technique for the analysis. If not than ordinary linear ADF and KPSS tests must be utilized.

Step # 3:

In the third and last step of the assessment, the FADF and FKPSS tests are incorporated to find out whether RER series can be illustrated as a stationary process through utilizing a suitable modeling that capture not only multiple structural breaks but also the nonlinearity adjustments. The outcomes can be interpreted as: In step # 3 if we reject the null hypothesis (in FADF) and alternative hypothesis (in FKPSS), and the F-test in step # 2 also reject the null hypothesis of linearity, then the RER series could be illustrated as a nonlinear stationary process around the multiple structural breaks. By contrast, if the FADF and KPSS tests fail to reject the null and the alternative hypothesis respectively but the F-test rejects the null hypothesis a country's RER series could be distinguish as a non-stationary process. However, assessment on the outcomes of the hypothesis tested must be made with a significant carefulness.

4.5 Basic characteristics of the real exchange rate

This portion of the thesis refers to basic characteristics and patterns of the real exchange rate of the Pakistan against its major trading partners. A summary of statistics on their real exchange rates is described in Table 1.

Table 1. Summary statistics of real exchange rates

Country	Mean	Median	Maximum	Minimum	Standard Deviation
Australia	62.36	61.61	91.34	40.17	12.15
Bangladesh	1.10	1.15	1.45	0.70	0.18
Belgium	2.37	2.45	3.21	1.33	0.39
Canada	73.43	74.02	95.90	54.18	10.01
China	1.48	0.62	9.20	-0.31	1.98
France	16.62	17.09	22.72	9.78	2.71
Germany	65.00	66.82	91.03	37.16	13.01
India	1.76	1.77	2.25	1.37	0.21
Italy	0.05	0.05	0.07	0.03	0.01
Japan	0.94	0.97	1.28	0.54	0.17
Kuwait	24.02	24.74	34.05	8.61	4.24
Malaysia	24.14	23.91	29.58	19.45	2.04
Netherlands	46.06	47.29	65.57	23.74	8.51
Oman	270.72	267.27	452.43	150.49	64.60
Saudi Arabia	23.00	23.08	30.95	16.88	2.76
South Africa	10.32	10.43	13.62	5.98	1.48
Spain	0.60	0.61	0.79	0.34	0.10
Turkey	33.61	36.21	74.73	1.12	20.11
UAE	26.75	27.75	37.32	14.20	5.37
United Kingdom	66.47	57.09	134.79	40.47	23.74
United States	80.77	79.13	107.12	62.28	9.91

Source: International Financial Statistics

As the table indicates, real exchange rate of these major trading partners was relatively very high in four countries i.e. Australia, Canada, France, Germany, Kuwait, Malaysia, Netherlands, Oman, Saudi Arabia, South Africa, Turkey, UAE, United Kingdom, and United States.

Oman had the highest average real exchange rate (270.72%) and the widest fluctuations (standard Deviation =64.60) in the real exchange rate. The lowest real exchange rate (0.05%) was in Italy; and this country had also the least volatile real exchange rate (standard Deviation =0.01). However, United States and Canada average real exchange rates were the second and third highest among the twenty-one major trading partners of Pakistan (80.77% and 73.43%) and standard Deviation in the real exchange rates were 9.91 and 10.01 respectively. Conversely, Spain and

Japan average real exchange rates were second and third lowest among the major trading partners of Pakistan (0.60% and 0.94%) and the standard Deviation in the real exchange rates were 0.10 and 0.17 respectively.

CHAPTER 5

EMPIRICAL RESULTS AND DISCUSSION

5.1. Introduction

The aim of this study is to apply the Fourier unit root tests on RER series in order to find out whether the Pak-rupee against its major trading partner stationary or not. To fulfill this objective, we have utilized data over the period $1983Q_1$-$2014Q_4$. The standard ADF and KPSS unit root tests have been tested against the Fourier approximation. The advantages of Fourier type unit root tests are that it considered multiple structural breaks along with the nonlinearity adjustment automatically.

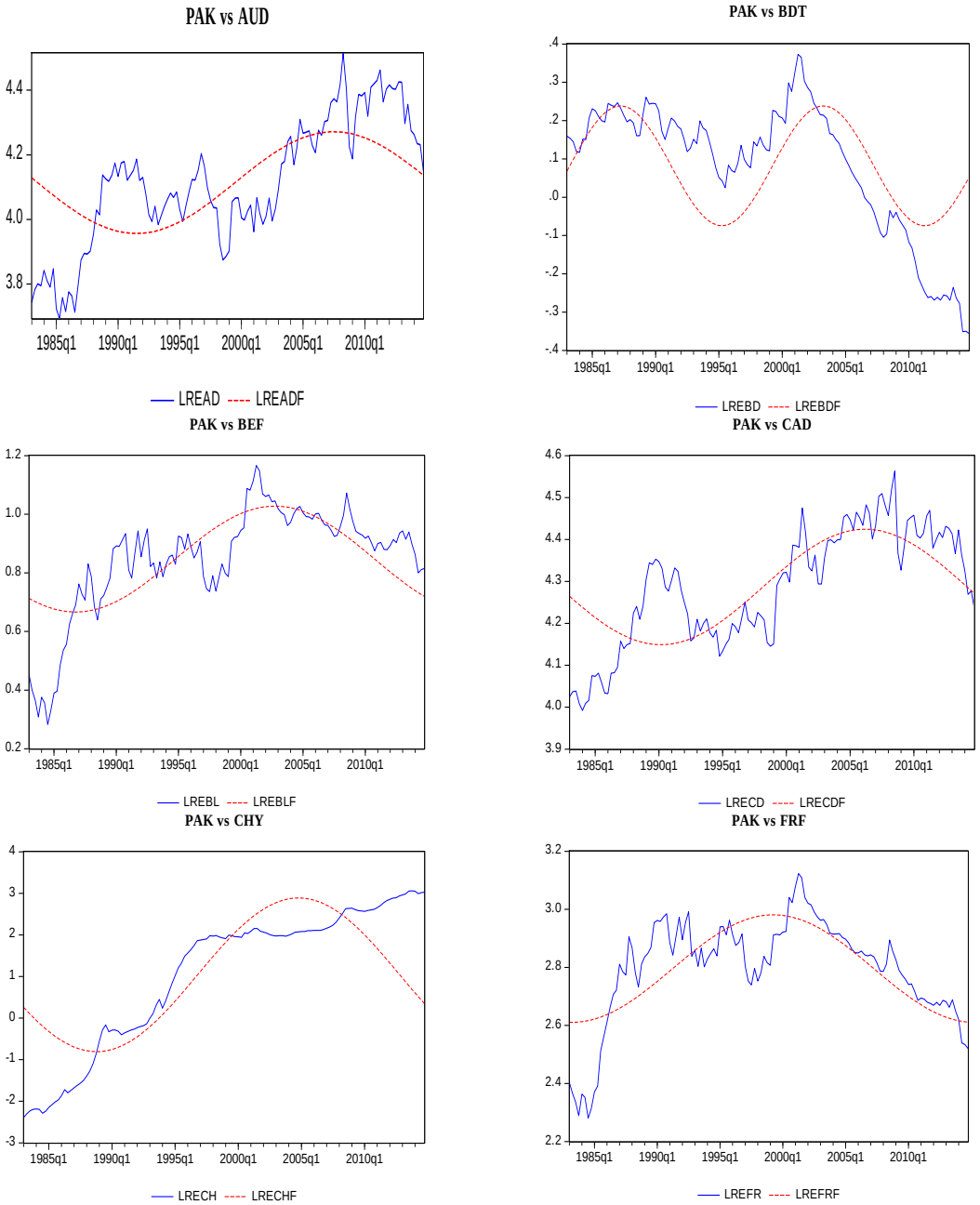
This chapter is arranged in the following manner. Session 5.2 reports the graphical representation of the real exchange rate of Pak-rupee against the currencies of its major trading partners. Session 5.3 presents the empirical results of ADF and Fourier ADF unit root tests along with their interpretations. Session 5.4 deals with the interpretations of KPSS and Fourier KPSS unit root tests.

5.2 Graphical Representation of RER

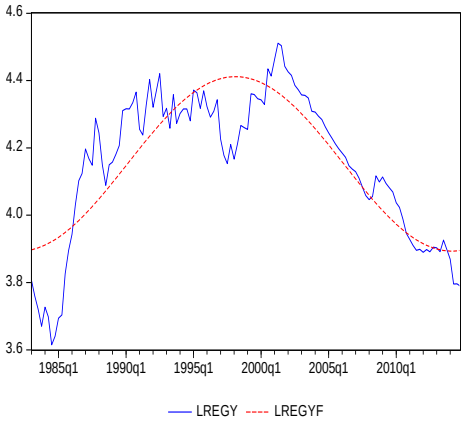
The time pathway of the real exchange rates (RERs) constructed in Pak-rupee against its major trading partners. The log RER_t series from equation 2 is plotted against the estimated Fourier function in Fig.1, where the positive change in the exchange rate shows real exchange rate depreciation. Structural breaks in the data are clear, and this gives good reason for taking into account of both sharp changes and smooth temporary breaks in testing for the unit root. The anticipated time paths of the time varying intercepts are also indicated in all figures. The actual nature of break(s) is generally unknown, and there is no precise guide as to where and how many structural breaks to consider in testing for a unit root or stationarity. A further

assessment of the figures shows that Fourier approximations look rational and supportive for the notion of long swings in the RER series.

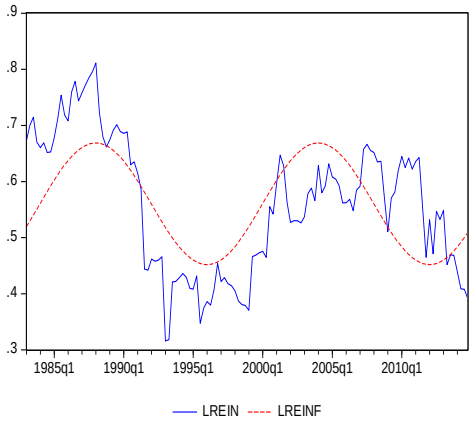
Figure 1: Time series plot of RERs for Pak-rupee against its major trading partners



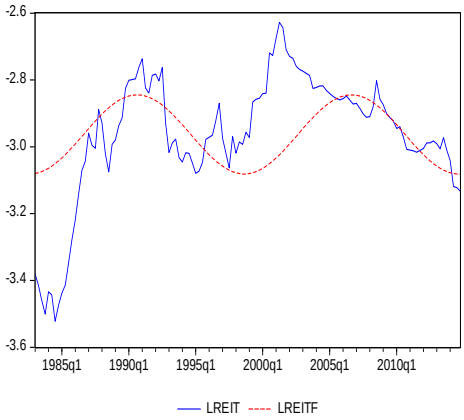
PAK vs DEM



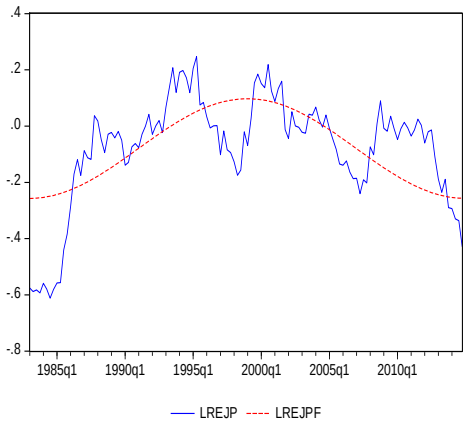
PAK vs INR



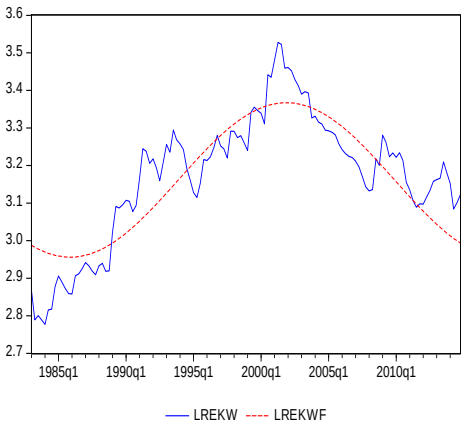
PAK vs ITL



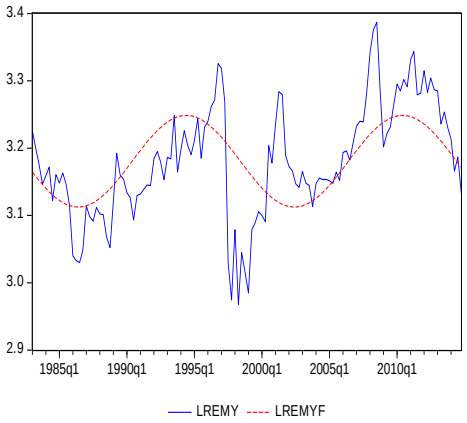
PAK vs JPY



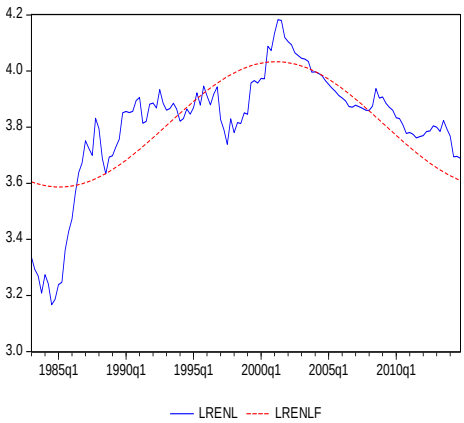
PAK vs KWD



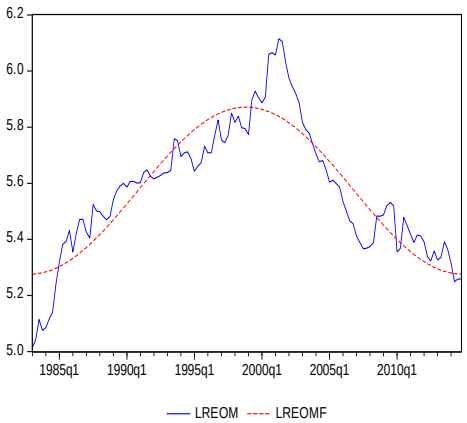
PAK vs MYR



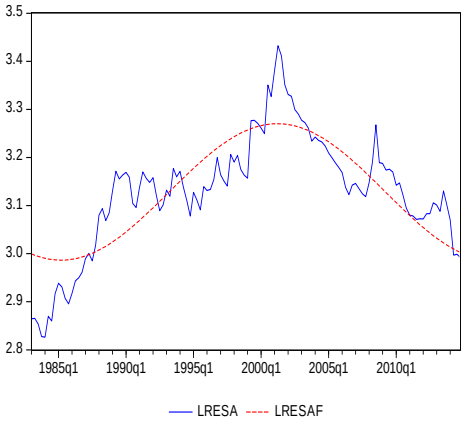
PAK vs NLG



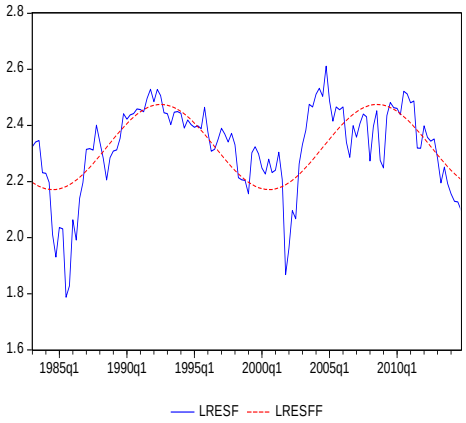
PAK vs OMR



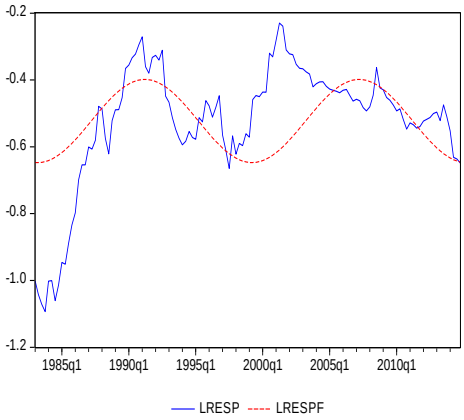
PAK vs SAR



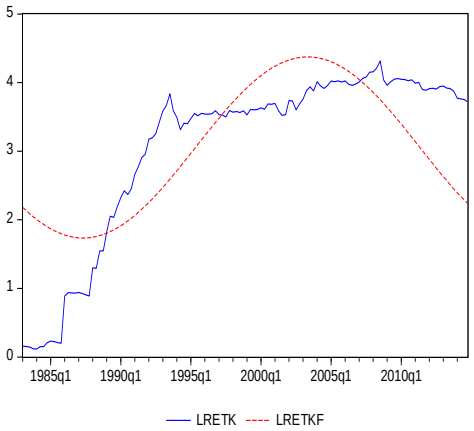
PAK vs ZAR



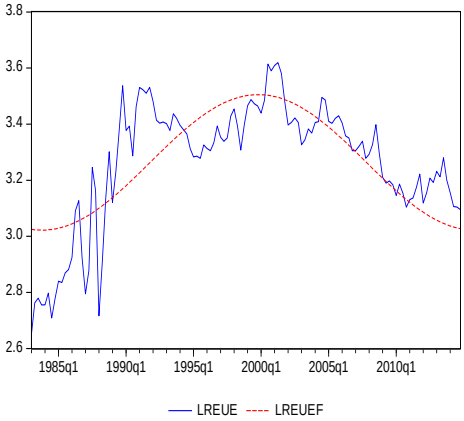
PAK vs ESP



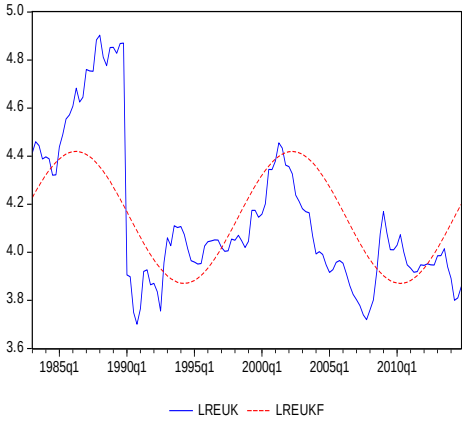
PAK vs TRY



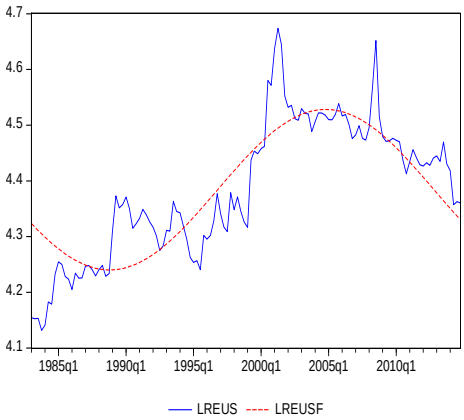
PAK vs AED



PAK vs GBP



PAK vs USD



5.3 Empirical Results of ADF and FADF

Initially we analyzed, linear unit root test (ADF) to check whether the RERs of Pakistan against its major twenty-one trading partners pronounce as stationary process. We selected the optimal lag augmentation by utilizing the Akaike Information Criterion (AIC). The results are reported in Table 2. As it is standard in the literature, we were incapable to reject the null of a unit root using the ADF test in the majority of the countries with the exclusion of Malaysia, South Africa, and Turkey. The standard ADF illustrate that the RER series of Malaysia, South Africa and Turkey are stationary process at the significance level of 5%, 10%, and 5% respectively.

Succeeding to next step procedure described in the previous chapter, we first fitted a Fourier model to the RER series and found best possible frequency ($\tilde{k}$) that minimized the sum of squared residual (SSR). The third column of table 2 presents the estimated optimal frequency ($\tilde{k}$). We can see that for all the major trading partner countries frequency is found to be 1 or 2. Table 1 indicates that, the optimal frequencies for Australia, Bangladesh, Belgium, India, Italy, Malaysia, Spain, Turkey, Canada, France, Germany, Japan, Kuwait, Netherlands, Oman, Saudi Arabia, United Arab Emirates, United Kingdom, and United States are set as 1. For China and South Africa the optimal frequency is set as 2. The optimal lag lengths recommended by the AIC vary from 1 to 6.

The F-test is utilizing to test the null of linearity i.e. $\gamma_1 = \gamma_2 = 0$ in equation (9). The null hypothesis is rejected for four trading partner countries, i.e. Australia, Canada, India, and Turkey. This means that the non-linear test, i.e. FADF must be utilize to estimate the RER series for all countries with the exception of Australia, Canada, India, and Turkey.

We then proceed to third-step of our testing procedure and obtained the OLS residuals from the Fourier function and applied the Fourier ADF test. The result from the FADF test is presented in column 8 in the table 1. The results of FADF obtained from step 1 and step 2 shows that the unit root test is rejected in case of Australia, Belgium, Canada, South Africa, and Turkey. As a result, the RER series in these five trading partner countries of Pakistan may possibly be described as a stationary process at significance level of 5%, 10%, 1%, 5%, and 1% respectively.

In a nutshell, the findings of the standard unit root test (ADF) indicate that the RER series are stationary only in three out of twenty-one trading partners i.e. Malaysia, South Africa and Turkey. Conversely, the empirical results from the FADF test show that the RER series in five out of twenty-one trading partners i.e. Australia, Belgium, Canada, South Africa, and Turkey can be illustrated as a stationary process around unknown multiple structural breaks.

Table 2: ADF and FADF Unit Root Test Results

	ADF	P-value	$\tilde{k}$	SSR	$\tilde{l}$	AIC	F(k)	FADF
Australia	-2.159	0.222	1	0.262	3	-3.018	7.391*	-4.0031**
Bangladesh	0.768	0.993	1	0.078	4	-4.209	4.384	-1.812
Belgium	-2.277	0.180	1	0.143	4	-3.489	3.932	-3.609*
Canada	-2.217	0.201	1	0.141	1	-3.603	14.806***	-5.508***
China	0.098	0.711	2	0.281	3	-2.849	1.924	-2.393
France	-1.919	0.322	1	0.164	3	-3.485	2.865	-2.13
Germany	-1.223	0.663	1	0.129	6	-3.494	2.148	-1.108
India	-1.746	0.405	1	0.117	6	-3.622	8.112**	-3.424
Italy	-2.166	0.219	1	0.148	3	-3.589	2.994	-2.211
Japan	-2.273	0.182	1	0.281	4	-2.816	1.705	-2.855
Kuwait	-1.814	0.372	1	0.109	4	-3.885	3.735	-2.868
Malaysia	-3.019**	0.035	1	0.187	3	-3.331	1.87	-3.382
Netherlands	-2.223	0.199	1	0.12	3	-3.795	3.307	-2.492
Oman	-2.019	0.278	1	0.151	4	-3.437	4.576	-2.563
Saudi Arabia	-2.054	0.263	1	0.088	4	-4.104	5.06	-3.095
South Africa	-2.819*	0.058	2	0.432	3	-2.419	2.756	-3.304**
Spain	-2.589	0.0978	1	0.144	3	-3.594	1.448	-2.122
Turkey	-3.169**	0.0242	1	0.445	3	-2.389	6.857*	-5.859***
UAE	-2.378	0.1503	1	0.164	4	-3.357	3.934	-2.859
United Kingdom	-1.890	0.3359	1	0.213	5	-3.061	2.245	-2.816
United States	-2.117	0.2386	1	0.103	4	-3.948	5.772	-3.486

Notes: The optimal lag $(\tilde{l})$ is the lag length that minimizes the AIC Criterion. The optimal frequency $(\tilde{k})$ is the frequency that minimized the SSR from equation (6). ***shows significance level at 1%; **shows level of significance at 5%; and * shows the level of significance at 10%. The critical values for ADF at 1%, 5%, and 10% are -3.482, -2.884, and -2.579 respectively. The critical values for FADF and F-test are taken from Enders (2012); Table 1b.

5.4 Empirical Results of KPSS and FKPSS

Initially we analyzed, KPSS unit root test to check whether the RERs of Pakistan against its major twenty-one trading partners pronounce as stationary process. We selected the optimal lag augmentation by utilizing the Akaike Information Criterion (AIC). The results are reported in Table 3. As KPSS is standard in the literature, it rejects the null of stationary in most of the cases, like Australia, Bangladesh, Belgium, Canada, China, Turkey, and United States at the significance level of 1%, Kuwait, Malaysia, Netherlands, Saudi Arabia, and United Kingdom at the significance level of 5%, and Italy, Spain, and United Arab Emirate at the significance level of 10%. On the other hands, KPSS stationary test also illustrate that the RER series of France, Germany, India, Japan, Oman, and South Africa are stationary process.

Succeeding to next step procedure described in the previous chapter, we first fitted a Fourier model to the RER series and found best possible frequency ($\tilde{k}$) that minimized the sum of squared residual (SSR). The third column of table 2 presents the estimated optimal frequency ($\tilde{k}$). We can see that for all the major trading partner countries frequency is found to be 1 or 2. Table 1 indicates that, the optimal frequencies for Australia, Bangladesh, Belgium, Canada, China, India, Italy, Malaysia, Turkey, France, Germany, Japan, Kuwait, Netherlands, Oman, Saudi Arabia, United Arab Emirates, United Kingdom, and United States are set as 1. For South Africa and Spain, the optimal frequency is set as 2. The optimal lag lengths recommended by the AIC vary from 4 to 7.

The F-test is utilized to test the null of linearity i.e. $\gamma_1 = \gamma_2 = 0$ in equation (9). The null hypothesis of linearity is rejected for all trading partner countries of Pakistan at 1% level of significance. This means that FKPSS unit root test should be utilize to

estimate the null hypothesis of stationary for RER series of all the major trading partner countries of Pakistan.

The results obtained from step 1 and step 2 show that the Fourier KPSS test reject the null hypothesis of nonlinear stationarity for Bangladesh, China, France, Germany, India, Italy, Japan, Turkey, and United Arab Emirates at 5% level of significance. As a result, the RERs in these nine out of twenty-one major trading partner countries of Pakistan may possibly be describing as a nonstationary process. The remaining twelve trading partners, i.e. Australia, Belgium, Canada, Italy, Kuwait, Oman, Malaysia, Spain, Netherlands, Saudi Arabia, United Kingdom, and United States can be illustrating as a non-linear stationary process only when a suitable model (i.e. FKPSS) is developed that not only capture unknown temporary structural breaks but also nonlinear adjustment.

In brief, the outcomes of the standard linear unit root test (KPSS) shows that RER series in six out of twenty-one trading partner countries of Pakistan had a stationary process. Alternatively, the empirical results obtained from the Fourier KPSS test illustrate that RER series in twelve out of twenty-one trading partners can be described as a non-linear stationary process around unknown multiple structural breaks.

Table 3: KPSS and FKPSS Unit Root Test Results

	KPSS	$\tilde{l}$	$\tilde{k}$	$\tilde{l}$	F(k)	FKPSS
Australia	1.014***	7	1	6	164.93***	0.118
Bangladesh	0.861***	7	1	7	71.12***	2.079**
Belgium	0.811***	7	1	6	42.83***	0.073
Canada	1.007***	7	1	4	210.65***	0.054
China	1.256***	7	1	7	30.851***	419.712**
France	0.298	7	1	7	32.70***	12.791**
Germany	0.303	7	1	6	37.98***	0.431**
India	0.303	7	1	6	63.06***	0.360**
Italy	0.426*	7	1	7	17.78***	1.070**
Japan	0.311	7	1	7	13.51***	0.490**
Kuwait	0.651**	7	1	6	90.78***	0.059
Malaysia	0.625**	7	1	6	18.05***	0.078
Netherlands	0.574**	7	1	6	41.62***	0.154
Oman	0.320	7	1	6	148.64***	0.153
Saudi Arabia	0.528**	7	1	6	77.86***	0.114
South Africa	0.169	6	2	6	20.04***	0.095
Spain	0.439*	7	2	6	21.35***	0.165
Turkey	1.047***	7	1	7	43.65***	5.245**
UAE	0.417*	7	1	6	39.38***	0.337**
United Kingdom	0.632**	7	1	6	33.23***	0.110
United States	0.999***	7	1	6	132.66***	0.078

Notes: The optimal lag $(\tilde{l})$ is the lag length that minimizes the AIC Criterion. The optimal frequency $(\tilde{k})$ is the frequency that minimized the SSR from equation (18). ***shows significance level at 1%; **shows level of significance at 5%; and * shows the level of significance at 10%. The critical values for KPSS at 1%, 5%, and 10% are 0.739, 0.463, and 0.347 respectively. The critical values for FKPSS, and F-test are taken from the paper of Becker et al. (2006); Table 1: (Without a Linear Trend)

CHAPTER 6

CONCLUSION AND POLICY RECOMMEDATION

6.1 Summary and Conclusion

This study has measured the real exchange rates of Pakistan against its major trading partners, through the application of the PPP theory. PPP theory is a RERs determination and compares the average price of commodities among the trading partners. To analysis whether the theory of PPP holds or not, we used newly developed FADF and FKPSS unit root tests that account for both the nonlinearity and multiple structural breaks, along with the ADF and KPSS unit root tests on bilateral RERs of Pakistan against its major trading partners. The rejection of null of unit root in case of FADF and the acceptance of null of stationary in case of FKPSS will suggest a multi-country version of PPP theory.

An essential contribution of this research study is that the outcomes tell us, large fluctuations truly exist in most of the RER series and they are incompatible with PPP theory. Therefore, it is necessary to consider these occasional temporary mean changes in the RER series before testing the stationarity or non-stationarity of the data. Our empirical outcomes show that in most of the cases RER series are found to be stationary process when multiple structural breaks and nonlinearity are taken under the consideration.

The outcomes provide support for the existence of PPP theory and the long run equilibrium in the RERs will be achieve when the RER series are determined by the whole sale price indexes. We found stationarity in twelve out of twenty-one trading partners, i.e. Australia, Belgium, Canada, Kuwait, Malaysia, Netherlands, Oman, Saudi Arabia, South Africa, Spain, United Kingdom, and United States in case of

FKPSS, and Australia, Belgium, Canada, South Africa, and Turkey in case of FADF. Therefore, it can be concluded that the equilibrium exchange rate among Pakistan and those twelve trading partners would adjust by the same magnitude, as the differences in the inflation rates among these countries. For this reason, the trading associations of Pakistan are influenced by the fluctuation occurring in the economies of all those trading partners. Therefore, in future time, Pakistan may come across beneficial to increase the trade capacity with all those above mentioned countries. This study also shows that PPP does not hold among the remaining nine trading partners of Pakistan, i.e. Bangladesh, China, France, Germany, India, Italy, Japan, Turkey, and United Arab Emirates. There are huge number of research studies and reasonable explanations for this kind of result. This might be due to greater transportation cost, tariffs, inflation differentials in trade and non-tradable barriers on commodities, (the Harrod Balassa Samuelson effect) amongst others which affect exchange rate, productivity differences and fiscal shocks.

6.2 Policy Recommendations

The core objective of this research study is to observe the validity of PPP theory for Pakistan against its major trading partners utilizing the quarterly data from the period of $1990Q_1$ to $2014Q_4$. The mean reversion hypothesis was checked by testing the stationarity of RER series. Standard unit root tests (i.e. ADF, KPSS) of RERs indicated that in majority cases PPP theory does not hold in case of Pakistan against its major trading partners. That's why, we utilized newly developed unit root tests, i.e. Fourier ADF and Fourier KPSS that considered both the nonlinearity and multiple structural breaks in the real exchange rates. The findings of these tests indicated the presence of PPP theory in twelve out of twenty-one trading partners of Pakistan. The

reasons for the existence of PPP theory in the trading partners may be due to: economy enlargement of Pakistan is deeply depending upon the developed countries and the Government of Pakistan increasing trade, finance and exchange rate liberalization policies since 1990. Price control on the various products was lifted and significant effects were made in opening the trade and improve payment systems. The relaxation of trade policies allowed the LOP to work more competently as shown in our findings which is supportive evidence of existence of PPP theory. The outcomes further indicated that the existence of PPP theory conforms the integration between the high degree of goods and foreign exchange markets. The short run departure from PPP theory has regularly take place, but the long run existence of PPP theory could not be ignored.

The core policy suggestions drawn from this research study includes: The outcomes of this study conform that exchange rates, foreign and domestic WPI based on PPP theory are co-integrated, for that reason, to adjust to inflation differentials the authorities must use PPP theory as a long term nominal anchor. The strength of Pak-rupee is further undermined by the depreciation of exchange rates.

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Appendix Statistical Tables

Results of KPSS and FKPSS (Constant & Trend)

	KPSS	$\tilde{l}$	k	$\tilde{l}$	F(k)	FKPSS
LREAD	1.014384***	6	1	5	60.71157	0.0547**
LREBD	0.861213***	7	1	7	152.8211	0.0817**
LREBL	0.81068***	7	1	6	39.09921	0.049109
LRECD	1.007168***	7	1	4	97.04704	0.047034
LRECH	1.255867***	7	1	7	153.9155	3.1896**
LREFR	0.29753	7	1	6	67.34861	0.048774
LREGY	0.302613	7	1	6	106.7682	0.053066
LREIN	0.302882	7	1	5	102.5536	0.0563**
LREIT	0.426007*	7	1	7	53.66771	0.2792**
LREJP	0.311354	7	1	7	4.301861	0.3582**
LREKW	0.651043**	7	1	6	86.52073	0.0586**
LREMY	0.625104**	6	2	6	7.561637	0.104629
LRENL	0.573816**	7	1	6	56.90365	0.0574**
LREOM	0.320234	7	1	6	137.0884	0.0688**
LRESA	0.527728**	7	1	6	82.74076	0.0111**
LRESF	0.169414	7	1	6	23.47928	0.052155
LRESP	0.439384*	7	1	7	29.20859	0.045865
LRETK	1.046587***	7	2	7	28.26613	1.3175**
LREUE	0.416693*	7	1	6	37.65262	0.0561**
LREUK	0.631836**	7	1	6	38.5637	0.053292
LREUS	0.999849***	7	1	6	82.28065	0.0592**

Major Trading partners of Pakistan from 2010- 2014

Total Trade 2010 (Millions, U.S. Dollar)				
Trading Partners	Exports	Imports	Total Trade	Percentage
China	1572.7	7629.26	9201.96	13.107
UAE	1699.47	4524.92	6224.39	8.866
United States	3389	2089.56	5478.56	7.804
Saudi Arabia	488.93	4569.82	5058.75	7.206
India	292.13	2475.98	2768.11	3.943
Malaysia	132.08	2513.62	2645.7	3.769
Kuwait	108.26	2355.7	2463.96	3.510
Germany	900.71	1127.4	2028.11	2.889
Japan	322.54	1446.28	1768.82	2.519
United Kingdom	970.69	730.44	1701.13	2.423
Italy	591.29	828.27	1419.56	2.022
France	415.48	549.54	965.02	1.375
Turkey	681.76	272.96	954.72	1.360
Netherlands	379.74	523.03	902.77	1.286
Canada	263.26	589.51	852.77	1.215
Belgium	355.69	417.57	773.26	1.101
Australia	149.62	538.96	688.58	0.981
South Africa	261.76	296.19	557.95	0.795
Spain	407.03	136.35	543.38	0.774
Bangladesh	381.82	75.51	457.33	0.651
Oman	118.2	235.07	353.27	0.503
Others	12157.53	10239.96	22397.49	31.903
Grand Sum			70205.59	

Total Trade 2011 (Millions, U.S. Dollar)				
Trading Partners	Exports	Imports	Total trade	Percentage
China	1,929.88	9,281.85	11211.73	14.46
UAE	1,954.38	5,746.65	7701.03	9.94
Saudi Arabia	562.27	5,803.67	6365.94	8.21
United States	3,483.74	2,187.66	5671.4	7.32
Kuwait	108.26	2,991.74	3100	4.00
Malaysia	230.8	2,805.83	3036.63	3.92
Germany	1,287.49	1,164.04	2451.53	3.16
Japan	414.11	1,869.89	2284	2.95
India	329.69	1,843.85	2173.54	2.80
United Kingdom	1,126.80	873.51	2000.31	2.58
Italy	740.24	749.64	1489.88	1.92
France	539.44	761.66	1301.1	1.68
Turkey	793.76	235.04	1028.8	1.33
Canada	263.41	762.58	1025.99	1.32
Netherlands	484.77	423.51	908.28	1.17
Belgium	454.77	408.46	863.23	1.11
Bangladesh	635.81	85.89	721.7	0.93
Spain	509.71	205.57	715.28	0.92
Australia	178.08	470.54	648.62	0.84
Oman	157.34	435.03	592.37	0.76
South Africa	261.76	269.76	531.52	0.69
Others	9593.18	12094.74	21687.92	27.98
Grand Sum			77,510.80	

Total Trade 2012 (Millions, U.S. Dollar)				
Trading Partners	Exports	Imports	Total trade	Percentage
China	2,855.63	10,206.93	13062.56	16.67
UAE	2,179.69	6,285.86	8465.55	10.80
Saudi Arabia	627.09	6,348.23	6975.32	8.90
United States	3,297.78	1,683.07	4980.85	6.36
Kuwait	120.74	3,272.46	3393.2	4.33
India	521.93	1,922.07	2444	3.12
Malaysia	229.34	2,037.79	2267.13	2.89
Japan	389.21	1,860.04	2249.25	2.87
Germany	990.72	1,229.64	2220.36	2.83
United Kingdom	1,051.62	904.7	1956.32	2.50
Italy	502.71	863.59	1366.3	1.74
France	417.24	763.69	1180.93	1.51
Australia	190.18	790.32	980.5	1.25
Oman	169.23	704.43	873.66	1.12
Netherlands	405.85	421.84	827.69	1.06
Turkey	504.56	303.74	808.3	1.03
Belgium	356.24	423.21	779.45	0.99
Spain	442.28	215.63	657.91	0.84
Canada	277.74	308.05	585.79	0.75
South Africa	252.76	268.93	521.69	0.67
Bangladesh	442.56	71.34	513.9	0.66
Others	9327.17	11915.43	21242.6	27.11
Grand Sum			78,353.26	

Total Trade 2013 (Millions, U.S. Dollar)				
Trading Partners	Exports	Imports	Total trade	Percentage
China	2,915.51	12,117.16	15032.67	18.41
UAE	2,440.46	6,319.49	8759.95	10.73
Saudi Arabia	702.12	6,382.20	7084.32	8.68
United States	3,352.99	1,810.38	5163.37	6.32
Kuwait	135.18	3,289.96	3425.14	4.19
India	339.74	2,472.41	2812.15	3.44
Germany	1,120.78	1,217.03	2337.81	2.86
Malaysia	199.71	1,824.92	2024.63	2.48
Japan	431	1,560.80	1991.8	2.44
United Kingdom	1,174.36	773.31	1947.67	2.39
Oman	234.61	1,181.13	1415.74	1.73
Italy	574.8	628.64	1203.44	1.47
France	453.83	719.18	1173.01	1.44
Netherlands	480.19	474.68	954.87	1.17
Belgium	393.16	522.73	915.89	1.12
Spain	512.73	208.33	721.06	0.88
Turkey	396.96	314.49	711.45	0.87
Australia	187.97	431.78	619.75	0.76
South Africa	272.74	343.07	615.81	0.75
Bangladesh	481.68	61.03	542.71	0.66
Canada	285.99	174.14	460.13	0.56
Others	9415.32	12325.87	21741.19	26.63
Grand Sum			81,654.56	

Total Trade 2014 (Millions, U.S. Dollar)				
Trading Partners	**Exports**	**Imports**	**Total trade**	**Percentage**
China	**2,509.44**	**14,573.27**	**17082.71**	**19.55**
UAE	**2,324.71**	**6,506.20**	**8830.91**	**10.11**
Saudi Arabia	**668.82**	**6,570.76**	**7239.58**	**8.29**
United States	**3,337.94**	**1,663.35**	**5001.29**	**5.72**
Kuwait	**128.77**	**3,387.17**	**3515.94**	**4.02**
India	**481.2**	**2,400.01**	**2881.21**	**3.30**
Germany	**1,333.13**	**1,174.54**	**2507.67**	**2.87**
United Kingdom	**1,477.62**	**920.31**	**2397.93**	**2.74**
Japan	**301.83**	**1,772.90**	**2074.73**	**2.37**
Oman	**201.03**	**1,652.96**	**1853.99**	**2.12**
Malaysia	**205.93**	**1,341.61**	**1547.54**	**1.77**
France	**524.83**	**776.88**	**1301.71**	**1.49**
Italy	**673.64**	**613.60**	**1287.24**	**1.47**
Netherlands	**547.59**	**545.85**	**1093.44**	**1.25**
Spain	**740.6**	**183.89**	**924.49**	**1.06**
Belgium	**435.92**	**466.82**	**902.74**	**1.03**
South Africa	**279.78**	**447.58**	**727.36**	**0.83**
Turkey	**395.95**	**285.25**	**681.2**	**0.78**
Canada	**286.23**	**386.92**	**673.15**	**0.77**
Australia	**190.74**	**417.29**	**608.03**	**0.70**
Bangladesh	**439.61**	**53.70**	**493.31**	**0.56**
Others	**9687.08**	**14049.06**	**23736.14**	**27.17**
Grand Sum			**87,362.31**	