PhD Dissertation

# Exchange Rate Misalignments and Volatility: Implication for Economic Activity and Prices in Pakistan

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**SCHOOL OF ECONOMICS**
**QUAID-i-AZAM UNIVERSITY, ISLAMABAD**
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Submitted for the fulfilment of the requirements for the
Doctor of Philosophy in Economics
at School of Economics, Faculty of Social Sciences,
Quaid-i-Azam University, Islamabad.

2023

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I hereby affirm that this thesis is my original work required for the completion of the PhD degree in Economics program at Quaid i Azam University, Islamabad, and that it has not previously been included in a dissertation submitted to this or any other institution for a degree, except for where due acknowledgement has been made in the text.

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This is to certify that the research work presented in this thesis, entitled "***Exchange Rate Misalignments and Volatility: Implication for Economic Activity and Prices in Pakistan***" was conducted by **Ms. Asma Fiaz** under the supervision of **Dr. Wasim Shahid Malik**

**Professor, SBP Memorial Chair**

No part of this thesis has been submitted anywhere else for any other degree. This thesis is submitted to the School of Economics, Quaid-i-Azam University, in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the field of Economics, School of Economics, Quaid-i-Azam University, Islamabad.

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## Abstract

Exchange rate policy is considered vital for correcting the macroeconomic imbalances. In Pakistan, it has been observed that historically, misaligned exchange rate not only created external imbalance but also intensified internal imbalance. Several studies have examined the relationship between exchange rates and macroeconomic variables. However, fluctuations and misalignment of exchange rates have been usually used separately in the literature, which might have provided biased results and inappropriate policy implications. In this study, we have used combinations of misalignment and fluctuations of the exchange rate along with its volatility (uncertainty) to examine the effects of the exchange rate on economic activity and prices.

For the analysis, monthly data have been used covering the period from 1980 to 2020. Purchasing Power Parity (PPP) and Behavioral Equilibrium Exchange Rate (BEER) methods have been applied to estimate the equilibrium exchange rate, whereas, in BEER, the equilibrium exchange rate is estimated through the simple regression framework as well as in the Autoregressive Distributed Lag (ARDL) model. In the next step, the state of misalignment (overvaluation or undervaluation of exchange rate), estimated from these models, has been combined with the state of exchange rate fluctuations (appreciation or depreciation), which results in four scenarios with respect to fluctuations and misalignment. Finally, Generalized Autoregressive Conditional Heteroscedasticity (GARCH) has been used to estimate the exchange rate uncertainty. The effects of exchange rate and its volatility on economic activity and general price level have been estimated in the context of these four scenarios using linear as well as nonlinear ARDL models. The economic activity in the analysis, proxied by the quantum index of Large-Scale Manufacturing (LSM), has been used as the response variable, while the exchange rate, in the context of combinations of misalignment and fluctuations, has been used as an independent variable, along with the interest rate, the inflation rate, oil prices, trade openness, and exchange rate volatility as control variables. The list of control variables has been altered by including money supply, fiscal deficit and aggregate income, while excluding the inflation rate in the model with the general price level, proxied by consumer price index, as response variable.

It has been found that both fluctuations in the exchange rate as well as misalignment of the exchange rate, when considered separately, negatively affect economic activity and general price level. However, the results of conventional Nonlinear ARDL (NARDL) show that appreciation has a negative effect, while deprecation has a positive effect on economic activity. Moreover, the results show that the exchange rate fluctuations have a positive effect on the economic activity when such fluctuations make exchange rates converge to the equilibrium level; in case of divergence the effect has been found negative. The results further show that real appreciation has a positive effect, while real deprecation has a negative effect on the prices. Moreover, it has been found that the exchange rate has a negative (positive) effect on prices when its fluctuations result in convergence (divergence) towards equilibrium exchange rate.

From our analysis, we conclude that currency depreciation or appreciation is not entirely harmful. Rather, the effects of fluctuations in exchange rate depend on whether or not such fluctuations move the exchange rate towards its equilibrium value. Thus, the findings implicate that the central banks' intervention in foreign exchange market, directly or indirectly through changing interest rate, is justified only if the exchange rate is getting away from its equilibrium value.

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# Chapter 1

## Introduction

Globally, it has been found that the exchange rate plays a vital role in the sustainable development of an economy, particularly in situations where macroeconomic imbalances exist. Thus, even in nations with poor institutions, exchange rate management policy is now viewed as a lever for economic growth (Johnson et al., 2006). In recent years, when economies have become more financially integrated, rapid exchange rate fluctuations are often observed. However, these rapid exchange rate fluctuations sometimes are not accepted by political governments as these cause uncertainty among economic agents. Thus, governments may maintain the exchange rate at an incorrect level.

Earlier, fluctuations and misalignments in the exchange rate have been used separately, while mostly considering them same (due to a close connection between the two). This research is based on the idea that both fluctuations and misalignment of exchange rates are distinct concepts, and when used simultaneously in the analysis, the results may change, and policy implications are different for the economy. Fluctuations in the exchange rate imply appreciation or depreciation in the exchange rate, while misalignment in the exchange rate leads to overvaluation or undervaluation of currency. Exchange rate fluctuations affect purchasing power and production costs, particularly when the economy is more dependent on imported goods. It has been found in the literature that fluctuations in the exchange rate have a negative effect on output and price level, particularly in transition economies (Aigheyisi and Adore, 2019). Although it has been argued that exchange rate fluctuations, depreciation in particular, leads to economic growth, the research has yet ignored whether the movement of the exchange rate make it move towards equilibrium level or away from it.

In the context of misalignments, an overvalued or undervalued exchange rate have implications for capital inflow and outflow, currency speculations, and the level of competitiveness in the economy (Giovannini, 1988, Cottani et al., 1990). Literature also

found that in some economies, overvaluation of the exchange rate might damage macroeconomic performance, while having some political benefit associated with it. In contrast, the undervalued currency stimulates investment, exports, and jobs (Demian and Mauro, 2018). Therefore, overvaluation and undervaluation both have positive and negative effects on the economy, depending on the state of the economy (Belanger et al., 1992; Bini-Samghi, 1991; and Hahn, 2007).

This research is based on the argument that fluctuations cannot always be harmful to the economy. It depends on the movements in the exchange rate relative to the equilibrium level. The exchange rate fluctuations may bring the exchange rate close to or further away from its equilibrium level. Both movements, towards the equilibrium exchange rate and away from the equilibrium exchange rate, have different impacts on macroeconomic variables. Thus, derived from the research gap in the literature, this study has used a combination of misalignments and fluctuations. Thus, this thesis considers the idea that using only fluctuations or using only misalignments of the exchange rate in any analysis may lead to biased results, which do not provide appropriate policy prescription. This research thus combines misalignment (overvalued/undervalued exchange rate) with fluctuations (appreciation/depreciation of exchange rate) by constructing four cases. Case I refers to overvaluation with appreciation and Case IV represents undervaluation with depreciation; both depict divergence from equilibrium. Case II overvaluation with depreciation and Case III represents undervaluation with appreciation; both are considered convergent cases.

In Pakistan, the exchange rate remained highly unstable after 1982, when a fixed exchange rate regime was abandoned, while managed float was introduced, which was further changed to floating exchange rate regime in 2000. Different research conducted in this context found that most of the time the exchange rate remained overvalued (Husaain, 2018). However, in some of the episodes, especially from the late 1990s to the early 2000s, the exchange rate was undervalued. An overvalued and undervalued exchange rate is maintained

for political gain, especially in underdeveloped countries. Thus, the Pakistani government kept the currency overvalued to inspire public trust and on the assumption that a strong economy was associated with a stable nominal exchange rate (Akhtar et al. 2017). Dollar and sheets (2020) advocates for strong policies for strong currency, asserting that these serve the national interest and contribute to a well-functioning international order.

Further, keeping the exchange rate at the wrong level (deviation from the equilibrium) to show its false stability resulted not only in the loss of foreign exchange reserves but exaggerated macroeconomic imbalances. These circumstances led to a situation with no options other than opting for the IMF program. Until now, twenty-two programs have been signed with the IMF. In every program, it was argued that the initial cause of macroeconomic imbalances was a misaligned exchange rate. Thus, the initial condition of every program was to make massive depreciation. Further to lowering inflation, it was also required to increase the interest rate, and make fiscal consolidation. However, there are episodes when the performance of the economic activity and inflation remained much different from the desired level. Thus, implying that there were policies ineffectiveness which may be due to examining misalignment and fluctuations of exchange rate alternatively. Thus, the combination of exchange rate misalignment and fluctuations is necessarily required for effective policy implications.

Therefore, to study the relationship between exchange rate and macroeconomic variables, it is requisite to estimate the variation of the exchange rate relative to its equilibrium value. In this research, thus, the ***first objective*** is to estimate the misalignment of the exchange rate. For estimating misalignment of the exchange rate, the equilibrium exchange rate is estimated by Purchasing Power Parity (PPP) and Behavioral Equilibrium Exchange Rate (BEER) Methods. The BEER has been estimated by the simple regression framework as well as by the ARDL model. Furthermore, in the BEER method, the explanatory variables for estimating the equilibrium exchange rate include Net Foreign

Assets, Terms of Trade, Government Consumption, Government Investment, and Interest Rate Differentials. In the end, volatility of exchange rate is measured through GARCH models, known as uncertainty.

The research thus enables us to capture the effects of exchange rate misalignment and fluctuations along with volatility (uncertainty) on macroeconomic variables, especially on economic activity and general price level. There is extensive literature on the impact of exchange rates on economic activity. In the case of Pakistan, it has also been found that GDP growth rates remained restrained due to severe macroeconomic imbalances. These imbalances mainly occurred due to rapid exchange rate fluctuations or misalignment in the exchange rate. The ***second objective*** is to estimate the impact of the exchange rate on economic activity. For the analysis, economic activity has been used as response variables, while combining misalignment and fluctuations of the exchange rate in four cases have been taken as main variables of interest; interest rate, inflation rate, oil prices, trade openness, volatility, and real effective exchange rate, have been used as control variables. For the analysis, six different empirical models have been estimated, including three models using linear ARDL structure. It is mentionable that conventional ARDL is based on the assumption that the impacts of explanatory variables on the dependent variable are uniform as it linearizes the positive and negative changes. In the literature, NARDL incorporates nonlinear effects of changes in explanatory variables on the dependent variable. Thus, the conventional NARDL decomposes variations into positive and negative changes. This thesis further extends NARDL to incorporate the four cases of combined misalignment and fluctuations of the exchange rate along with the volatility of the exchange rate.

In economics, a lot of literature has been found discussing the impact of exchange rates on consumer prices, which can be direct as well as indirect. It is also mentionable that exchange rate misalignment and fluctuations affect the consumers' purchasing power. Therefore, the policy maker always tries for price stability. The reason is that the price level changes

strongly affect the economy's economic growth as well. Therefore, the ***third objective*** is to estimate the effect of the exchange rate on the price level. The Consumer Price Index (CPI) has been used as the response variable in the analysis, while real effective exchange rate in the context of four cases of combined misalignment and fluctuation has been used as explanatory variable. Further, aggregate income, interest rate, money supply, oil prices, fiscal deficit, and volatility of the exchange rate have been used as control variables in the analysis.

It has been found that when used separately, both fluctuations and misalignment have a negative impact on economic activity in linear models. When the nonlinear ARDL Model is used, however, appreciation has a negative impact on economic activity whereas depreciation has a positive effect. When fluctuations and misalignment are combined then the findings indicate that exchange rate fluctuations positively affect economic activity in convergent cases, whereas negatively impact economic activity in divergent cases.

In the price level analysis, the results of the linear models indicate that both depreciation and fluctuations and undervaluation, when used separately, have negative impact on prices. Regarding the NARDL Model, real appreciation has a positive effect, whereas real depreciation has a negative effect on the price level. However, by incorporating both fluctuations and misalignments simultaneously, it has been found that exchange rate depreciation has a negative effect on prices in convergent cases and vice versa in divergent cases.

For policy implications, it is recommended to take into account both exchange rate misalignments and fluctuations when attempting to achieve macroeconomic balance. Thus, the policy implication is that only maintaining an overvalued or undervalued exchange rate may not have a detrimental effect on economic activity, whereas using a combination of both may give accurate analysis and policy decisions to enhance economic activity. Like is the case for prices. This means that currency depreciation or appreciation is not generally harmful. It depends on the deviation of the exchange rate from its equilibrium value and its

movement towards or away from the equilibrium. Consequently, there are arguments for and against central bank intervention. Thus, if the exchange rate has deviated from its equilibrium or is moving farther away from equilibrium, the central bank should intervene in the foreign exchange market, either directly by selling and buying foreign exchange, or indirectly through changing interest rate.

The remainder of the thesis is organized as follows. Chapter 2 overviews empirical literature relevant to the research. Chapter 3 provides an overview of the Pakistan economy. Chapter 4 discusses methods for estimating exchange rate misalignments and uncertainty of exchange rate. Chapter 5 explores the effects of exchange rate variations on economic activity. The influence of exchange rate misalignments and fluctuations along with volatility on price level is discussed in Chapter 6. Conclusion and policy recommendations drawn from the research are mentioned in Chapter 7.

# Chapter 2

## Literature Review

Prior to Bretton Woods System, the exchange rate was not able to gain the center of importance in macroeconomic variables. In 1944 the Bretton Woods System was established for stable international currency exchange rates. It was based on collection of uniform rules and regulations to provide the essential foundation. Although, currencies were pegged to the U.S dollar, still exchange rate was considered an important variable in context macroeconomic imbalances of the economy. With the passage of time and further integration of countries in commerce, systemic issues began to emerge. Thus, Bretton Woods System began to collapse as a result of a series of events beginning in 1967, especially when gold's convertibility into dollars and SDRs was withdrawn. On 15 August 1971, President Nixon stopped the dollar's convertibility to gold, bringing down Bretton Woods. The unified fixed exchange rate regime ended in 1973.

Thus, explaining exchange rate fluctuations in the post-Bretton Woods era on the basis of macroeconomic fundamentals became challenging. Realizing the deficiency of fixed exchange rate system, in advanced economies, the exchange rate policies then diverted toward flexible exchange rate system. Thus, literature of that time, focused on the selection of appropriate exchange rate systems for achieving macroeconomic balances, still the debate is not over. In Least Developed Countries, still exchange rate is pegged with other currency. For example, Nepal has pegged its currency with Indian currency.

Recent research has focused on estimating the equilibrium exchange rate and studying the impact of exchange rate variations on macroeconomic variables. Still by this time, even for developed economies, the relationship between fluctuations in exchange rates and macroeconomic activity is ambiguous and complex. Thus, determining the level of currency misalignments became an area of interest. There can be two types of variations one is

fluctuations leading to depreciation and appreciation while the other is misalignments (deviation from equilibrium exchange rate) leading to devaluation and overvaluation. However, even by this time both concepts are used alternatively for making any economic analysis.

Thus, there is need to understand variation in exchange rate to differentiate fluctuations and misalignments of exchange rate. As mentioned earlier, both fluctuations and misalignments are used alternatively even in recent literature. It is considered that fluctuations may adversely affect the economy. But fluctuations may lead the misaligned exchange rate to the equilibrium rate, in which case the economic impact will be different. Consequently, it is necessary to investigate the impact of the exchange rate on macroeconomic variables, particularly economic activity and pricing, by employing both fluctuations and misalignments concurrently.

**2.1 Evolution of the Literature on Exchange Rate**

From the Bretton Woods System until the present, three systems of exchange rate prevail globally: fixed exchange rate and flexible exchange rate. But countries also try to have managed exchange rate regime as well. There is still no agreement to use fixed or floating exchange rates. The reason being that each has its own distinct advantages and disadvantages based on the economy's features.

It was suggested that a stable exchange rate encourages commerce and investment in the economy, resulting in long-run growth. However, Mexican crisis, (1995), Asian crisis (1997) etc., are related to disadvantages of fixed exchange rates which started from financial crises eventually leading to economic crises. Further for maintaining fixed exchange rates, foreign reserves were lost. Thus, countries started following floating exchange rate regimes. Practically, it was also observed that in a floating regime, the central bank still intervened ensuring stability. However, the intervention of the central bank led to uncertainty thus encouraging speculative movement of hot money.

Later in modern macroeconomics, analyzing the impact of sterilization became the center of research. As an effective instrument in macroeconomic management, adjustments in the exchange rate may have major consequences for the external sector of a country especially balance of payments (Gala and Lucinda, 2006). Further, the exchange rate powerfully affects cross-border economic activity particularly in trade, investment, tourism, and international migration (Conrad and Jagessar, 2018).

Literature provides explanations for a number of factors thought to influence exchange market fluctuations. Still, these considerations aren't universal and can differ significantly between nations. In addition, different economies place different emphasis on the same factors that affect the exchange rate. Frenkel, (1976) found that future expectations, prices, and money supply drive exchange rates, but Dornbusch, (1979) found that interest difference is vital and has a substantial role. Exchange rates are determined by trade dependency and openness, financial integration, and price level (Heller,1978). Stockman, (1980) said that demand and supply determine the inflation rate, which affects the exchange rate.

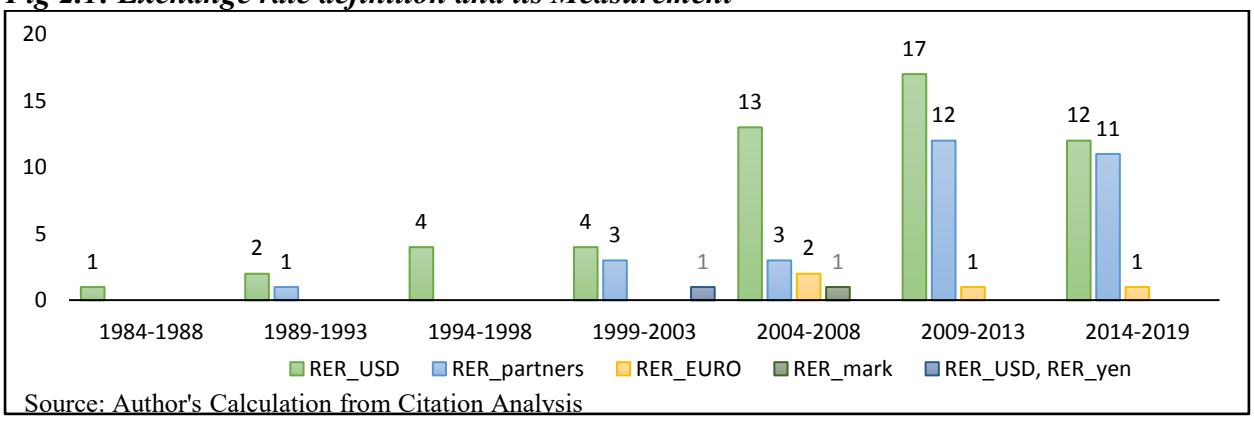
Sazami and Yoshimura, (1999) explored that how East Asian exchange rate regimes could be restructured. To minimize major volatility in the region, the research emphasized on Fixed Exchange Rate regime. In contrast according to Liang, (1998) the value of the exchange rate was not influenced by the regime changeover. Bouoiyour and Rey, (2005) investigated the Moroccan currency rate regime. They discovered that as fluctuations in exchange rate rises affect the economy's trade balance. As trade expanded, nominal to effective exchange rates became the focus. Effective exchange rate compares a currency to a basket of others. Thus, an effective exchange rate is the weighted average of a basket of foreign currencies used to measure a country's competitiveness and inflationary risk.

Summarizing, currency depreciation and appreciation both have its related advantages and disadvantages. However, both were discussed in relation to one other currency, mainly dollar. With the passage of time, trade expanded globally, and the performance of domestic currency was not related to one specific currency, but currencies of trading partners became significantly important. Thus, numerous national and international organizations also started estimating Real Effective Exchange rate (REER). Real exchange rates, as a macroeconomic variable, affect the relative international prices of domestic goods, having a direct effect on competitiveness, exports and imports, economic activity, unemployment, and inflation. Further, compatibility of currency was linked with its equilibrium level. Thus, deviation of from equilibrium level will then lead to misalignments. Thus, there is a need to understand Equilibrium Exchange Rate.

## 2.2 Equilibrium Exchange Rate

Different methods were used to estimate the exchange rate equilibrium. PPP is the first method where steady-state level is independent of price level. However, PPP is considered a long run phenomenon where prices have been adjusted across countries. In recent literature, BEER approach is used to estimate the equilibrium exchange rate. This approach incorporates macroeconomic variables. Fig. 2.1 illustrates the trend exchange rate's definition used in the 100 most-cited studies [1].

***Fig 2.1: Exchange rate definition and its Measurement***




Source: Author's Calculation from Citation Analysis

[1] Citation Analysis is given in Appendix A

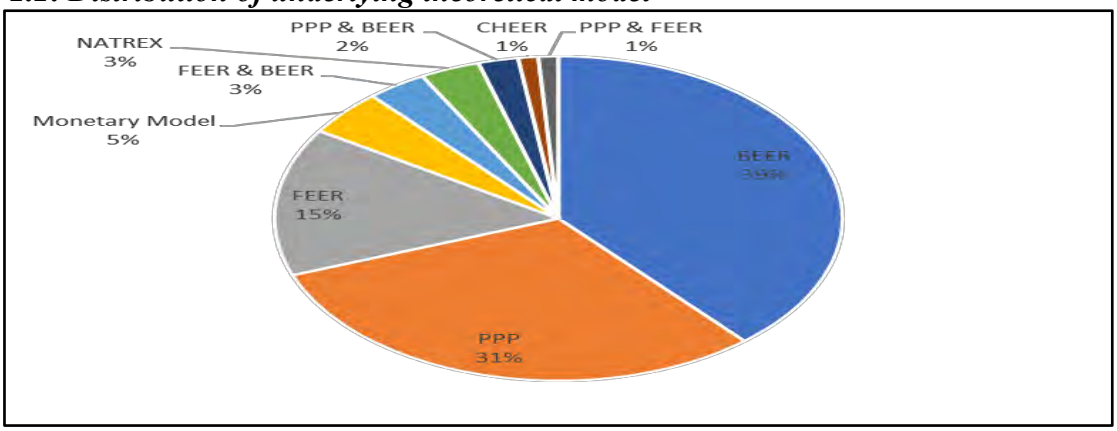
It was observed that in most of studies used the US dollar to measure REER since the US dollar is widely used as an international currency. Thus, the real effective exchange rate was considered an indicator to depict the health of the economy.

**2.3 Econometric methodology used for estimating misalignments of exchange rate.**

Using theoretical models, the equilibrium real exchange rate can be measured. The equilibrium real exchange rate was historically defined by absolute and relative PPP. Recent methodologies have been developed to estimate the exchange rate's equilibrium level.[2] For example Williamson, (1996) established the Fundamental Equilibrium Exchange Rate (FEER), while Clark and MacDonald introduced the Behavioral Equilibrium Exchange Rate (BEER), (1999)[3,4].

These are widely used methods for this purpose. Fig – 2.2 presents the distribution of different underlying models based on 88 empirical studies in the top 100 papers. BEER model has been used by 39%, whereas PPP has been used by 31% studies followed by FEER by 15%.

***Fig 2.2: Distribution of underlying theoretical model[5]***

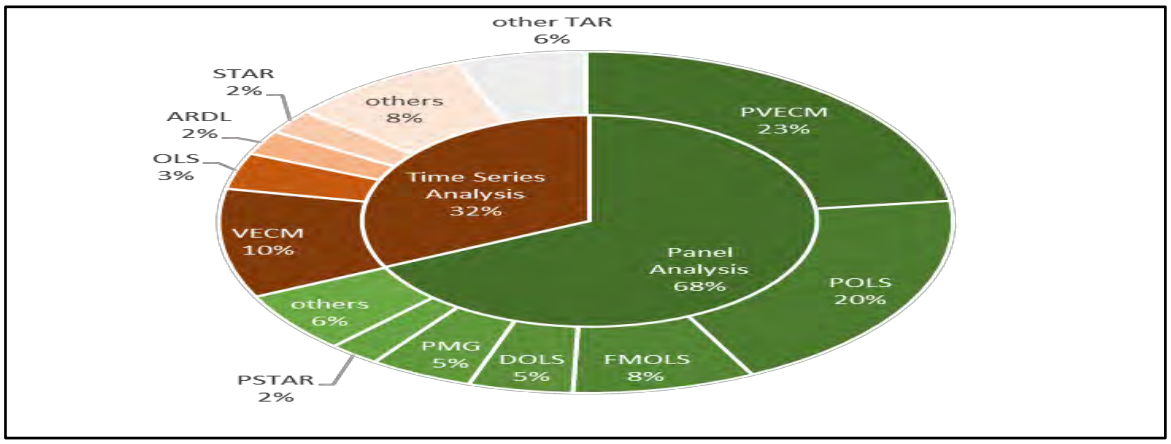



Source: Autor content analysis of 100 papers

[1] FEER is similar to the BEER in that it ensures both internal and external balance, however FEER is a partial equilibrium model.
[1] based on the assumption that the "behavior" of the REER is determined by the "behavior" of its economic fundamentals in the long run (Clark and MacDonald 1999)
[1] Purchasing Power Parity (PPP), Fundamental Equilibrium Exchange Rate (FEER) and Behavioral Equilibrium Exchange Rate (BEER), Capital Enhanced Equilibrium Exchange Rates, (CHEER) Natural Real Exchange Rate. (NATRIX)

The selection of a suitable methodology is a tough task to measure the real exchange rate misalignments. The choice of methods is governed by the type of data used in the study. As mentioned earlier, there are two types of data sets: panel data and time-series data sets. Different techniques have been used for both types of data. The inner circle in Fig 2.3 represents the share of time series and panel data, which were 68% and 32%, respectively. Some studies have recently used Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS). In time series analysis, the Vector Error Correction Model (VECM) is widely used followed by the simple regression framework and Autoregressive Distributed Lag Model (ARDL).

***Fig 2.3: Econometric Methodologies of measuring misalignments***




Source: Author's Analysis

### 2.3.1. Purchasing Power Parity Model

Gustav Cassel, (1922) who introduced the Purchasing Power Parity, made the first attempt to find an equilibrium exchange rate. According to the PPP hypothesis, exchange rates should work to make domestic prices roughly comparable across nations. Linear regression and cointegration tests are frequently employed in the literature to evaluate the PPP theory.

In their study of the equilibrium exchange rate for India using the PPP method, Patnaik and Pauly, (2001) found that while the exchange rate tends to move slowly towards equilibrium over the long run, it is extremely volatile over the short run. Zhang and Zou,

(2014) used a variety of measures to test the PPP theory. They used the original general price level and concluded that the exchange rate is nonlinear and that estimating it as a linear yield deceptive result. Innizzotto, (2001) concluded that persistent nonlinearities occur in exchange rate series in European countries. In Pakistan, Qayyum et al., (2004) investigated currency rate mismatch using PPP. It was found that the Pakistan rupee is largely undervalued (lower than equilibrium level).

### 2.3.2. Behavioral Equilibrium Exchange Rate (BEER) Model

BEER is an extension to the PPP model. However, this method is aligned with underlying economic fundamentals. Clark and Macdonald, (1998) were the first to use BEER method for estimating equilibrium exchange rate. Chen and Macdonald, (2015) estimated equilibrium exchange rate by using vector error correction model.

Comunale, (2019) calculated misalignments of exchange rate by BEER approach. A data set of 28 European Union countries for the period 1994 – 2012 was used. It was found that mismatch was massive, and the patterns varied widely among the selected countries. Coudert and colleagues, (2018) investigated the equilibrium exchange rate. They employed the Pool Mean Group method and used data of 187 countries. They found that misalignments in underdeveloped countries were different from that in rich countries. Chen and Macdonald, (2015) demonstrated that misalignments of exchange rates exist from the time since single currency system adopted in the EU.

Baak, (2017) investigated yen misalignments of exchange rate by using BEER approach. According to the research, the yen is misaligned. Bannaga and Badawi, (2014) applied an error correcting model to estimate misalignments. It was recommended that if there is an exchange rate misaligned, policymakers must intervene to lessen the misalignments.

Wang et al., (2007) investigated the misalignments of the Chinese currency rate. They used a data set from 1980 to 2004 and applied a vector error correction approach. Duttagupta

et al., (2006) raises a number of methodological problems in estimating the equilibrium exchange rate. They approximated the results using the BEER approach taking data from 12 OECD member countries. Misalignments in transition economies are investigated by Kim and Korgonen, (2005). The results revealed that currencies in transition economies are overvalued. Clark and MacDonald, (2004) used BEER findings to indicate that macro fundamental factors have a key role in predicting misalignment in exchange rate. Guclu, (2008) investigated exchange rate regimes and their determinants using data from 1970 to 2006. For analysis PROBIT model was applied. The results revealed choice of exchange rate regime depends on GDP per capita, trade openness, capital account, inflation, and terms of trade.

Earlier, only linear aspects were considered in estimating equilibrium exchange rate. However, the non-linearity aspect is also critical. Shin et al., (2014) claimed that the NARDL approach is more appropriate in case of hidden cointegration asymmetries. Thus, understanding the nonlinearity of the exchange rate is essential.

### 2.4 Nonlinearity of Exchange Rate Effects

Taylor and Peel, (2000) was the first who described the nonlinear adjustment of the long-run exchange rate. He used quarterly time-series data of three countries. He found the results by applying the STAR model, cointegration technique with nonlinear ARDL model. Iannizzotto, (2001) explained the misalignments of exchange rate and nonlinear convergence to purchasing power parity by applying the STAR model. According to the findings, a greater inflation rate combined with a flexible exchange rate system result in a more rapid pace of adjustment.

Likewise, Dufrenot et al., (2003) studied the nonlinearity in exchange rate. It was found that there is nonlinearity in the equilibrium value of the European exchange rate. Westerhoff, (2009) findings added cyclic behavior into the misalignments. The exchange rate nonlinearities and cyclic behavior were investigated. STAR model was used to conclude

that when there are more exchange rate misalignments, market stability reduces due to nonlinearity.

Chaouachi et al., (2004) used a nonlinear cointegration method to model exchange rate misalignments. STAR model was applied to the data from 1957 to 2002. It was found that the exchange rate has a nonlinear mechanism. Reitz and Taylor, (2008) investigated the foreign exchange rate coordination channel by applying the STAR model to daily data from 1980 to 1992. It was discovered that state bank involvement is an effective route for the market to function smoothly. According to findings, Nonlinearity in exchange rates was crucial, but there is possibility that in the presence of an outlier, the model may produce completely different results. Villavicencio, (2008) looked at the nonlinearity or outliers in exchange rates that matter the most. Monthly data for fourteen developing nations from 1980 to 2005 were analyzed using the STAR model. The research found that nonlinearity in most of the cases was rejected which thus altered the results. The reason being that if outlier is considered, it will reduce the presence of nonlinearity. There is a need to understand channels through which exchange rate effects macroeconomic variables.

### 2.5 Channels through which Exchange Rate affects Macroeconomic Variables

There are three main channels by which the exchange rate influences the economy's macroeconomic variables. *First*, the exchange rate influences output via the demand channel. There are four subchannels inside the aggregate demand channels. The first element is consumption; as the exchange rate fluctuates, imported goods become more expensive, hence influencing individual consumption. The second subcomponent is the investment channel: when the exchange rate varies, individuals or corporations become hesitant to invest, and as a result, investment is lowered, affecting overall economic production. The net export channel is the last in aggregate demand; as exchange rates fluctuate, imports and exports are affected, and aggregate demand changes**. S**ervice prices are more sensitive to exchange rates especially in the short run (Cole and Nightingale, 2016). Pass-through can be

determined not only by the nature of the export but also by the exporting firm's characteristics. Amiti et al., (2014) demonstrated that, while pass-through is practically complete for small non-importing enterprises, it is only half complete for large import-intensive exporters. Berman et al., (2012) discovered that highly productive enterprises adjust their markups, resulting in reduced pass-through in reaction to currency swings. The elasticities of trade can also be influenced by factors at the country level. Bussiere et al., (2014) discovered that EMEs have larger export price elasticities than advanced economies, owing mostly to macroeconomic variables. Indeed, they discover a correlation between export and import price elasticities across countries.

The *second* channel is aggregate supply. In case of appreciation, companies expand provided production in anticipation of decreased raw material costs. Most economists agree that in the short run, the investment had little or no effect on supply but in the long run it had a strong impact. According to Blecker, (1989) depreciation leads to higher markup and profit-sharing. Devaluation, according to Bhaduri and Marglin, (1990), increases costs, which leads to higher product pricing and a rollover of the cost increase to higher salaries. Taylor, (2004) on the other hand, claimed that wages are inelastic in relation to exchange rates. However, real wage can fall leading to decrease in demand through decrease in consumption. According to Kandil et al., (2007) fluctuations in exchange rate have impact on the product's cost and competitiveness, affecting the price level.

The *third* channel is the balance sheet channel, in which local currency appreciation strengthens the balance sheets of foreign currency domestic borrowers, relaxing domestic financial conditions. Because of foreign exchange appreciation, this "financial axis" of exchange rates may function as a counter to the trade channel, increasing domestic economic activity through simpler financial circumstances. A depreciation, on the other hand, might harm the economy by weakening domestic financial statements. As an alternative, an appreciation lowers the relative value of domestic currency financial inflows while

increasing the relative value of foreign currency financial outflows. In this way, when the exchange rate is changed, increased, mostly, the debt amount is increased and the balance sheet is changed and, in the end, economic activity is affected. According to some researchers, for example Laski and Podkaminer, (2012) flexible exchange rate regime helps firms reduce currency risks by reducing currency mismatches in their balance sheets. Because the central bank doesn't guarantee the exchange rate's level, enterprises don't take on as much currency risk as they do under a fixed exchange rate system.

**2.6 Exchange rate Fluctuation and its Impact**

Earlier, the exchange rate was not able to gain the center of importance in both exogenous as well as endogenous growth model. Even for open economies, the exchange rate was not considered an important variable in initial growth models. Solow, (1956) and Romer, (1990) emphasized economic growth but the exchange rate was missing. Exchange rate fluctuation, however, became a major factor in economic growth after the 1990s, mostly as a result of financial integration (Lothian, 2000). To what extent the exchange rate affects various economic factors remains a contentious topic in the research field.

If the economy's exchange rate volatility is significant, the possibilities of resources being misallocated in the economy are higher. According to the IMF, (1984), exchange rate volatility influenced resource allocation in both tradeable and non-tradeable sectors also affecting competitiveness of country.

Casino and Oxley, (2013) explored two channels through which the economy is affected by exchange rate fluctuations; one is called the spending effect when prices of tradeable products have changed the consumption of tradeable goods is affected and individual spending pattern is changed which ultimately affects economic activity in both sectors. The second is called the resource movement effect which is, when wages and prices of the tradeable sector become high, the non-tradeable sector wage and prices also become high due to expectation. Volatility hurts exports and imports, according to De Grauwe,

(1988) and Arize (1988). Oskooee, (1985) says depreciation is short-term bad for the trade balance but long-term positive influences the economy Edwards, (1998).

Some thought exchange rate changes could increase trade volume (Delias and Zillberfarb, 1993). Some investigations concluded that exchange rate variations don't affect trade volume (Assery and peel, 1991 and Tenreyro, 2004). Hooy and Choong, (2010) studied the influence of exchange rate variations on intra-regional trade flows in SAARC and found that risk-averse market participants respond by favoring margin trading. In Bangladesh, India, Pakistan, and Sri Lanka, exports, income, price differentials, and currency rate volatility are in steady-state equilibrium. Exchange rate volatility boosts real exports in most South Asian countries, but not all.

Auer and Schoenle, (2012) studied sector-specific exchange rate pass-through. The pass-throughs vary depending on which side - importers or exporters - the exchange rate adjustment occurs; it's also higher the larger the trade partner's import share. Delatte and Lopez-Villavicencio, (2012) observed similar short-term and long-term findings. Peltzman, (2000) says importers only react to large currency rate movements. Bussiere, (2007) analyzed sector-level export and import prices using G7 data. Both asymmetrical and non-linear exchange rate responses were seen. Fang et al., (2009) studied the currency rate-export effect link. Jabara, (2009) studied how currency changes affect import prices. The US currency rate has less of an impact on import prices than the EU and Canada. Asian imports pass through less than Canadian imports.

Trinh, (2014) using ARDL and the error correction model studied relationship between exchange rate fluctuations and trade balance in case of Vietnam. It was concluded that depreciation led to a positive effect on trade in the short run. Ozturk and Kalyoncu et al., (2009) found exchange rate fluctuations adversely affect trade balance. Choudhry and Hassan, (2015) studied volatility and imports. Using ARDL, they identified a link between the exchange rate and imports.

Dincer and Khandil, (2011) studied exchange rate fluctuations' impact on exports. It was concluded that random fluctuations in the exchange rate led to an asymmetric effect on sectoral growth of exports. Unpredicted changes in the exchange rate had an adverse impact on export through demand and supply channels. Overtime exports are sensitively related to exchange rate fluctuations. Furthermore, the stability in the exchange rate improves the growth of sectoral exports. Javaid and Farooq, (2009) researched the real exchange rate appreciation due to foreign inflows, which reduces tradeable sector and expands non-tradeable sector. Exchange rate changes affect export growth, resource allocation, consumption patterns, private investments, and employment. (Aron et al., 1997; Edwards,1989; Savastano, 1999). Kandlil and Mirzaie, (2008) researched exchange rate changes on output and pricing. The exchange rate impacts macroeconomic variables asymmetrically. Further Kandil, (2015) found that predicted exchange rate changes affect macroeconomic variables unevenly. Khin et al., (2017) evaluated exchange rate effects on GDP and food prices. Applying nonlinear ARDL. Exchange rate variations affect GDP and prices asymmetrically.

Devereux and Yetman, (2002) explained the asymmetry in the case of appreciation and depreciation. The research explained that depending on the time and direction of movement, exporters and importers responded differently. If there is monopolistic scenario, appreciation is more important than depreciation since there is more probability of raising prices of the goods. If a monopolist is faced with a menu cost or a switching cost, reaction will be different.

Inflation and exchange rate changes are strongly connected in the economy. Individual consumption patterns are affected by inflation, which is an essential determinant in the economy for short and long-term policy decisions. Because they affect the business cycle, the capital stock of the economy, interest rates, wages, and living standard of individuals in the economy. As a result, the economy's fiscal and monetary policy decisions

are influenced (Carroll, 2006). Alexander, (1952) linked inflation and exchange rates. Inflation affected people's expenditures. Inflation uncertainty impacts spending habits, demand and supply, and productivity. Recent research found the same thing (Iyke and Ho, 2018). Pollard and Coughlin, (2003) studied exchange rates and prices. The data show a positive relationship between prices and exchange rates, but no asymmetric influence across industries.

The relationship between devaluation and inflation was studied by Odusola and Akinlo, (2001). The research concluded that currency depreciation causes inflation. Blanchard and Perotti, (2002) defined government spending shocks as any innovation other than government spending shocks having an immediate impact on government spending. Positive government spending innovation enhanced output, the trade balance, and the real exchange rate. A breakthrough in government expenditure increases output and demand but worsens the trade deficit and weakens the real exchange rate (decreases domestic prices relative to foreign exchange-adjusted rates).

Husian, (2005) studied exchange rate effects on inflation and output. The author says swings affect inflation and economic production. Short- and long-term effects exist. Exchange rate volatility determines inflation. Khundrakpam, (2007) found exchange rate variability affects inflation. Exchange rate variations affect the economy's price level, according to Volkan et al. Devaluation raises import prices, which raises production costs, input prices, and domestic prices. Foreign demand increases domestic pricing and inflation.

Monacelli and Perotti, (2008) discovered that tradeable items have stickier pricing than non-tradeable goods, even with the same shock. A steady exchange rate controls pricing, according to Omotor, (2008). Jabara, (2009) explored how exchange rates affect import pricing. We experienced a less impact on import prices from exchange rate changes than the EU and Canada. Asian imports pass through less than Canadian imports. Byrne and Nagayasu, (2010) found that exchange rates affect domestic prices. Stable inflation controls

economic production and growth. Przystupa and Wrobel, (2011) studied exchange rate pass-through in Poland. Exchange rates asymmetrically affect inflation and productivity. Each variable's influence is distinct.

Due to the extensive discussion on equilibrium exchange rate, by this time policymakers and academics had shifted their focus toward exchange rate misalignments from exchange rate fluctuations. However, still, the use of combination of both is missing in the literature.

### 2.7. Exchange Rate Misalignment and Its Impact

The role of exchange rate regimes in minimizing misalignments is studied by Dubas, (2009). Annual data for 102 nations from 1973 to 2002 by using the DOLS method. It was revealed that while the regime was critical in preventing misalignments for poor countries, it became irrelevant for developed countries. According to Dooley et al., (2005), exchange rate misalignments affect competitiveness, which affects domestic output, investment, exports, and imports. GDP and employment are affected by the current account.

Branimir and Jovanovik, (2007) investigated the misaligned exchange rate and find that it has no major impact on the economy's macroeconomic factors. Sallenave, (2010) used Panel Vector Error Correction model and applied to a data set of G20 countries from 1980 to 2006 to find relationship between exchange rate misalignments and economic output. The. Empirics differed across industrialized and developing countries. Emerging countries have a larger economic impact than developed countries. For industrialized countries, the rate of convergence is faster. It was found that misalignments have a negative impact on macroeconomic performance. Elbadawi, Kaltani, and Soto, (2012) studied the relationship between misalignments, output, and foreign aid. 83-country panel Data from 1970 to 2004 from IFS was used for investigation while GMM technique was used. The results revealed that aid has no substantial impact on exchange rate fluctuations.

Caputo and Magendzo, (2011) studied US inflation and exchange rates. Other economic success indicators exist besides the exchange rate. Flexible exchange rates help governments attain flexibility. Holtemller and Mallick, (2013) investigated exchange rate regimes and currency crises from 1970-2006. Using Engle and Granger. Misalignments are a portent of tragedy. Caputo, (2015) studied exchange rate regime and misalignments. A panel of 54 countries and 1980-2011 annual data were used. Underdeveloped countries have inelastic exchange rate dynamics. Adjustment and appreciation rates vary by country. Each country's adjustments and appreciation vary. Owoundi, (2017) studied 17 Sub-Saharan African nations' misalignments and currency rate regime using yearly pool data from 1980 to 2011.

Baffer,(1997) investigated the measuring of misalignments and found that short and long-run misalignments are estimated differently. Short-term market clearing is vital, and macroeconomic fundamentals provide appropriate results for long-term misalignments. Gomes et al., (2003) investigate the link between inflation and currency misalignments. Applying the VAR method on quarterly data from 1986 to 1993. The researchers determined that misalignments had a detrimental effect on economic growth, however, undervaluation promotes exports. Bui et al., (2017) focused on Vietnam's currency and found that the currency was overvalued because of the economy's significant inflation.

Misalignments affect economic growth, according to Conrad and Jagessar, (2018). Macroeconomic fundamentals showed misalignments. Using annual data from 1960 to 2016, ARDL found that economic growth negatively affects exchange rate misalignments. Grekou, (2019) compared nominal and actual exchange rates. DOLS was applied on 1976-2009 data. Exchange rate depreciation is nonlinear.

Schrder and Ulivelli, (2017) studied exchange rate misalignments and emerging-market macroeconomic performance. Misalignments did not affect macroeconomic variables' functioning. Njindan, (2018) studied how misalignments affect middle-income

countries' productivity. Misalignments affect economic growth and productivity growth symmetrically.

Mazorodze and Tewari, (2018) studied misalignments on South African sectoral growth. Since undervaluation and growth are related, they decided that the currency should be kept undervalued. Gabriel and Missio, (2018) compared industrialised and emerging economies' economic complexity and real exchange rate. Misalignments are crucial for manufacturing growth. Maral et al., (2018) studied country dependency and currency misalignments. Misalignments affect macroeconomic performance, proving that countries are interdependent. Tipoy et al., (2018) studied misalignments and developing-country growth. Undervaluation affects economic growth through the tradeable sector's size. Wong, (2019) studied economic misalignments in Malaysia. Misalignments in manufacturing were studied. Undervaluation encourages economic growth, while overvaluation prevents it.

Mamun et al. (2020) used a single equation approach with the ARDL method to examine exchange rate misalignment in Turkey. They used the annual data from 1980 to 2016. Their result showed a positive impact of the undervalued exchange rate on economic growth. Furthermore, empirical evidence suggests that undervaluation can boost a country's growth. Similarly, another study explores the relationship between capital account openness and the misalignment of the exchange rates in 60 developing countries between 1980 and 2014, revealing a positive relationship between capital account openness and the misalignment of the exchange rates (Mahraddika, 2020). Similarly, Tarawalie (2021) examines the effect of different episodes of misalignment of exchange rates on the growth of Sierra Leone, a West African economy. They used data from 1980 to 2018 and found a strong link between misalignment episodes and economic growth.

**2.8. Literature related to Pakistan.**

Pakistan has experienced numerous exchange rate regimes since its independence. The first had a fixed exchange rate between 1947 and 1982, with two major devaluations (in

1955 and 1972) and one revaluation (in 1973). The second was a managed floating exchange rate regime from 1982 to 1998. Although the nominal exchange rate declined during this time, the flexible exchange rate that began in 1998 and continued through 2001 is still in effect today. Thus, research was done to determine the impact of the exchange rate on Pakistan's macroeconomic factors.

### 2.8.1. Effects of Exchange Rate Fluctuations

Hamid and Azka, (2017) found that in Pakistan, exchange rate remained overvalued. However, its management strategy has altered. Prior to March 2013, exchange rate stability was the policy goal. Then, nominal exchange rate stability vs the US dollar seems to be the goal. Overvaluation and subsequent currency rate shifts damage exports and manufacturing. This hurts economic growth and raises the risk of a balance-of-payments catastrophe.

Hussain and Shahnawaz, (2011) studied inflation and economic growth in Pakistan. Using 1960-2006 annual data. The study found a favorable correlation between Pakistan's inflation and economic growth. Causation between these two variables is unidirectional. Inflation drives growth, not vice versa. ECMs are used to study the relationship between economic growth and inflation. This helps examine short- and long-term relationships between variables. Anjum and Nasim, (1997) found that overseas price rises affect domestic inflation. In Pakistan, academics study how exchange rate fluctuations affect output, household pricing, and wholesale prices. Eatzaz and Samina, (1999) studied the rapidity of exchange rate and price movements and their pattern. They found that foreign price increases or devaluations affect Pakistan's domestic prices. Rehana and Naeem, (1999) found no association between exchange rate and domestic price level. Choudhri and Khan, (2002), on the other hand, concluded that the exchange rate had no effect on inflation. Faruqee, (2004) found that changes in exchange rate strongly impact both inflation and economic activity.

Shah and Hyder, (2004) investigated exchange rate pass-through on inflation in two ways: one is direct and the other is indirect. In the case of domestic prices, the pass-through is weak, but it is strong in the case of wholesale prices. It was also discovered that the impact on domestic prices lasts for a year with an intense impact in the first four months. It was also found that during inflationary periods, the pass-through is stronger than during non-inflationary eras. Monthly data from 1988 to 2003 was used while VAR method was applied. According to empirical evidence, exchange rate volatility affects CPI and WPI. However, the influence on WPI was greater than the effect on CPI. A flexible exchange rate system had a lesser effect on inflation as compared to a fixed exchange rate system.

Mohammad, (2010) investigated the trade imbalance and the rate of exchange. Mahmood et al., (2011) studied macro-economic variables and exchange rate fluctuations. It was concluded that exchange rate and GDP had a positive relationship while trade openness and FDI were negatively linked. Abbas and Raza, (2013) examined the trade deficit's relationship to economic growth. It was discovered that there was a moderate link between the exchange rate and a trade imbalance. It was concluded that Pakistan's exports exceed its imports, and that the country's deficit has worsened since independence.

Malik et al., (2015) studied Pakistan's trade balance and economy. Asymmetric export-import factors affect the trade balance. The exchange rate hurt the trade balance; the study found. Pakistan's currency depreciated and its trade imbalance grew. Pakistan's exchange rate pass-through was researched by Shaikh and Hussain, (2015). The consumer price index had a lower impact on exchange rate fluctuation than wholesale price index. Javed and Ahmad, (2016) found that exchange rate depreciation affects consumption, saving, investment, and pay pattern. Ahmed et al., (2017) studied Pakistan's exchange rate and exports. The exchange rate correlated negatively with exports but positively with global income. Zamir et al., (2017) investigated exchange rate's impact on important economic factors Exchange rate fluctuation hurts inflation, economic growth, FDI, and foreign

reserves. Alam et al., (2017) analyzed export to major markets and currency rate volatility. Exchange rate volatility may help some export sectors. Examined: food, textile, and manufacturing. Some sectors are more affected. Bader and Riazuddin, (2006) explained that exchange rate depreciation boosted exports and imports. Akhtar et al., (2009) analyzed Pakistani exports and currency rate volatility. Ahmed et al., (2018) studied exchange rate volatility's effect on export-import and prices. Exports and imports link exchange rate changes to inflation.

Nawaz and Ghani, (2018) studied depreciation and output. Currency depreciation improves short-term trade terms but hurts long-term output. Ali et al., (2018) identified a relationship between exchange rate, trade balance, and GDP. Kumar et al., (2019) studied currency volatility's impact on consumption. Exchange rate volatility and external debt reduce short- and long-term domestic spending.

According to Sidra, and Qayyum, (2014), increased oil demand in Pakistan indicates economic growth. According to shock dummies, oil prices have the biggest impact on Pakistan's GDP. This study uses the Cobb Douglas production function to simulate total oil consumption and Pakistan's oil price to assess the influence on GDP. Using yearly data from 1972-2011, the context of Pakistan, the Likelihood technique of Johansen cointegration (1979) and Granger causality, (1988) test by putting constraint on dynamic model are used to assess order of integration, long run and short run dynamics, and causal link between variables. The long run and dynamic link have been discovered for all variables except total and oil price, which have no short-term effect on GDP. Long-term, oil prices hurt real GDP, but short-term, they help. Oil usage (across industries) is linked to economic growth.

Rashid et al. (2022) investigate the impact of exchange rate volatility on firms exporting activities in the case of Pakistan. They used a two-step system-GMM estimator and a large panel of nonfinancial firms' data from 2001 to 2016. The results showed that the firm’s export is significantly and positively linked with an increase in REER. However, the

volatility of the exchange rate is found to be significant and negatively related to export decisions, implying that firms reduce their exports during periods of increased unpredictability in exchange rates. Financially unconstrained firms are less affected by volatility in exchange rates than financially constrained firms. They concluded that financial constraints are a much bigger issue than the volatility of the exchange rate regarding the exports of firms. Akhtar et al. (2022) investigated the effect of foreign exchange rate volatility on Pakistan's trade with significant trading partners. The impact of third-country exchange rate volatility on Pakistan's trade with major trading partners is investigated by Akhtar et al. (2022). From January 1981 to January 2018, the researchers examined monthly data on Pakistan's exports and imports. They use the NARDL technique to account for the asymmetry effect in traders' responses of exchange rate volatility. The results showed a significant impact exchange rate volatility on trade. The results showed that the third-country effect is significant and asymmetric in both the short and long run in all export and import models.

Rashid and Basit (2022) investigate determinants of the volatility in exchange rates in Asian economies. Using the data from January 1997 to March 2019, variables such as foreign reserves volatility, industrial production, terms of trade, gold prices, and government consumption. The underlying variables' volatility is measured using the GARCH model. The findings show that exchange rate volatility in the previous period significantly influences the current period in all countries. In the Asian countries studied, the volatilities of the underlying macroeconomic variables have varying relationships with ERV. They conclude that each type of volatility has a different impact. It varies from country to country.

Oskooee et al. (2020) investigated the symmetric or asymmetric impact of volatility on trade flows in the case of China and Pakistan. They used annual data from 1980 to 2018, and the results showed that volatility in the exchange rate has asymmetric effects on trade

flows in almost all industries and that these effects persist in 40-50% of the industries over time both in the long run and short run with non-linear models producing more significant results.

Iqbal et al. (2020) investigate the volatility of exchange rate effect on industrial-level trade flows, both symmetric and asymmetric, in the case of Pakistan-US trade. The study spans the years 1981 to 2018, allowing for a thorough examination of long-term trends. The findings show that the asymmetric significant impact of exchange rate volatility on trade flows is almost fifty percent of the importing and exporting industries participating in trade between Pakistan and the USA. These effects are observed in the long run, as the short-run results suggest.

### 2.8.2. Exchange Rate Misalignment in Pakistan

Most studies have focused on identifying the drivers of exchange rate misalignments, economic factors impacting the exchange rate, extent, and direction. Khan et al., (2005) used the purchasing power parity theory to study Pakistan's currency rate misalignments from 1982 to 2002. Long-run PPP is true, but adjustment is delayed, and the currency rate is undervalued. WPI and exchange rate cointegrated. Mustafa and Nishat, (2005) studied Pakistan's exchange rates and export growth. Volatility hurts short- and long-term trade partner export growth. Kemal, (2005) reported that exchange rate instability reduces a country's growth rate. Exchange rate volatility has a positive but negligible effect on exports but a negative and considerable effect on imports.

Hyder and Mahboob, (2006) calculated the equilibrium exchange rate by using 1978-2005 data. The Engle-Granger two-step Estimation technique is applied. The variables include terms of trade, remittances, investment, openness, productivity difference, and capital-to-GDP ratio drive exchange rate changes. The results showed that 1978 exchange rate was undervalued and 2005 overpriced. Undervaluation was owing to the dollar's fall

against other major currencies, and overvaluation was due to foreign currency availability. The results demonstrated that the equilibrium REER varies with the economy's fundamentals, making sound monetary policy vital for Pakistan's efforts to maintain a stable exchange rate. A large price gap may boost the REER and misalign the exchange rate. Qayyum, (2004) found through PPP that the real exchange rate remained overvalued relative to the dollar. The Pakistani Rupee was overpriced in 2006. Hussain, (2008) noted that the currency rate was overvalued from 1970 to 1978, close to equilibrium from 1978 to 1988, then overvalued from 1989 to 1999 and 2000 to 2007. As per findings deteriorated terms of trade and inflation remained responsible for overvaluation of Pakistani Rupees from 2000 to 2007. Johansen cointegration was used to determine cointegrating vectors among the variables.

Janjua, (2007) used Engle Granger cointegration to evaluate the impact of exchange rate misalignments on exports of Pakistan. Study applied 1978-2006 data. Nominal and real variables impact the exchange rate. If the economy deviates significantly from equilibrium, the central bank should take corrective actions. According to the study it was found that external trade is itself an outcome of economic development. There is no doubt that misalignments of the exchange rate affect external trade adversely. However, there are many other factors affecting external trade such as competition, state of technology and economy etc. In study, cointegrating vector amongst the variables was applied and it was found that Pakistani Rupees remained undervalued in 1978.

According to Khan, (2008), methods used to estimate the misalignments of exchange rate usually ignore issues like endogeneity, which thus provide seriously biased results. Siddiqui et al., (1996) analyzed exchange rate misalignments using 2SLS. Misaligned exchange rates affect the current account deficit. Instead of frequent devaluations, regulating

domestic prices can prevent a current account deficit. Policies that promote resource efficiency can also assist in maintaining a stable and competitive exchange rate.

Debowicz & Saeed, (2014) It was also overvalued in 2010. Ahmed & Hussain, (2018) reported mixed REER over/undervaluation results. However, the Pakistani rupee was often overpriced. Zakaria, (2010) used GMM estimate to study REER misalignments' influence on Pakistan's economic development during variable exchange rate regimes. The REER in Pakistan was devalued from 1983 to 2005, leading to economic development.

Jaffri & Ahmed, (2010) studied FDI's effect on Pakistan's REER. The authors used BEER and cointegration to assess misalignments and determine macroeconomic fundamentals' exchange rate impact. Foreign investment and remittances have boosted the native currency. Dubas, (2009) found that floating exchange rates cause misalignments in underdeveloped nations. Mallick, (2012) discovered that fixed causes more misalignments than floating. Debowicz and Wajiha, (2014) used VAR to study exchange rate misalignments and Pakistan's economic development. Undervaluing somewhat encourages growth. Realigning the rupee to its equilibrium, determined by economic fundamentals, will enhance the tradable sector's size due to productivity gains. Rodrik's, (2008) argued that undervaluation stimulates Pakistan's economic growth. The results showed a long-term link between REER, Real GDP, trade terms, and FDI. Various eras have misalignments.

The majority of studies have found that a low exchange rate promotes economic growth, whereas an overvalued one has the opposite effect. Moreover, for the same period many other studies have also reported overvalued exchange rate at some stages. The difference may be due to estimation techniques used for the analysis. Undervaluation does not support economic growth in Pakistan, contrary to common belief. Variability in empirical study results may be attributable to econometric methodologies and explanatory

factors. REER misalignments have a negative influence on economic performance, according to extant literature. Empirical studies show that macroeconomic policy factors such term of trade, interest rate difference, trade openness, production methods, technical progress and innovation, Government consumption, and foreign investment influence REER misalignments. Similarly, the currency rate is affected by the regime and institutions.

Ahmad and Ali, (1999) estimated Pakistan's overall price level and exchange rate simultaneously. Price level and exchange rate adjustments to domestic or external shocks are slow. Anti-inflationary interventions, like monetary contraction, have progressive impacts. Inflation's neutralizing influence on the actual exchange rate after devaluation can't be delayed forever. Long-term anti-inflationary and exchange rate policies cannot be enacted independently; the focus must be on monetary authority-controlled policies, such as money supply. However, as Pakistan has to import oil which has major share in import bill, the change in prices of oil internationally can also change domestic inflation. Thus, given Pakistan's heavy reliance on imported fuels. Malik, (2016) found that high oil price volatility hurts the economy. According to the study energy prices affect Pakistan's inflation. Using a modified Phillips curve, it was analyzed that oil price changes' impact on Pakistan's inflation. The analysis found a strong link between oil prices and inflation, especially over the last year.

Jahan and Irshad (2020) explore the impact misalignment of exchange rate on economic growth by utilizing the data from 1980 to 2016. The results showed that misalignment had a negative impact on economic growth. However, the study discovers that the effect is lessening if financial development is increased in the economy. Therefore, they concluded that financial sector development is important for growth of the economy. In contrast ali and Aqil (2022) explore the effect of f misalignment of exchange rate on economic growth but found a positive relationship between misalignment and economic growth.

Several studies have been undertaken to determine the effect of exchange rate fluctuations or misalignment on macroeconomic variables, especially growth and price level, by taking into account various intervening variables. However, changes in the exchange rate were either captured by fluctuations or by using misalignment. Thus, the research gap exists in using combination of fluctuations and misalignment in exchange rate to capture impact of variations in exchange rate on macroeconomic variables especially growth and price level. This study is thus based on hypothesis that using combination of fluctuations and misalignment in exchange rate will provide better policy implications.

**2.9 Conclusion**

Recent research on the impact of currency changes on Pakistan's economy focuses on the symmetric link between the exchange rate and macroeconomic variables such GDP, interest rate, inflation rate, trade balance, and public debt. Pass-through is studied in terms of CPI, WPI, export, and import inflation. Some studies have linked currency changes with pay patterns through inflation and interest rate channels, but only one has investigated the asymmetric impact on manufacturing.

Exchange rate regimes vary because the exchange rate shouldn't vary from equilibrium. Many policymakers/economists focus on its effect on macroeconomic indicators. Some economists believe the exchange rate is a nominal variable, hence they examine its effect on inflation or the passthrough effect on nominal variables.

In Pakistan's economy, most work involves analyzing the linear influence of exchange rate variations on domestic pricing, exports, imports, and economic growth. The exchange rate influences nominal and real factors of the economy, according to a study. The exchange rate was usually off-balance. When it deviates from equilibrium, convergence is nonlinear.

Despite the quantity of studies on the linear impact of exchange rate fluctuations on economic activity, most overlook disaggregated/monthly analyses. In literature no study was

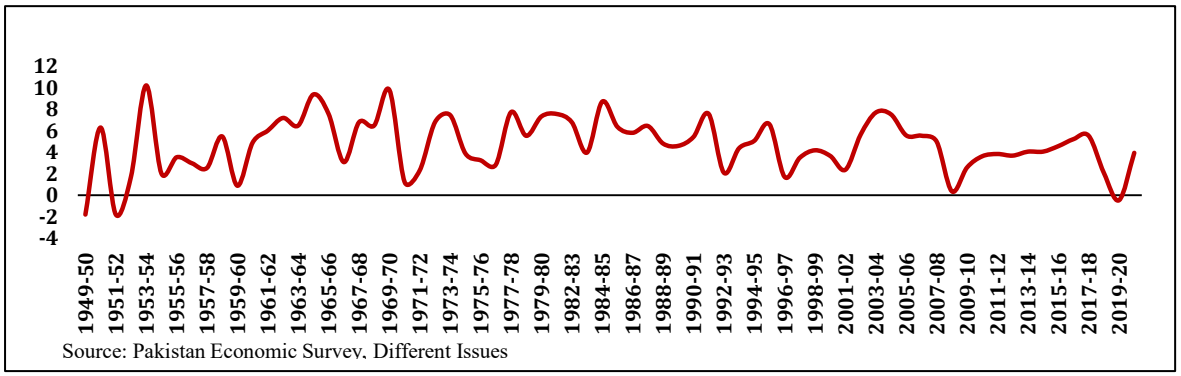
found which has used a combination of misalignment and fluctuations in exchange rates. This research used a combination of misalignments and fluctuations in exchange rate to address the research gap. The nonlinear impact of exchange rate changes on prices and economic activity will also be examined in the study.

## Chapter 3

# Overview of Pakistan's Economy

Historically, Pakistan's GDP growth remained in the boom-and-bust cycle since the beginning. Usually, these fragilities in economic growth were related to structural issues.

***Fig -3.1: GDP Growth Rate***

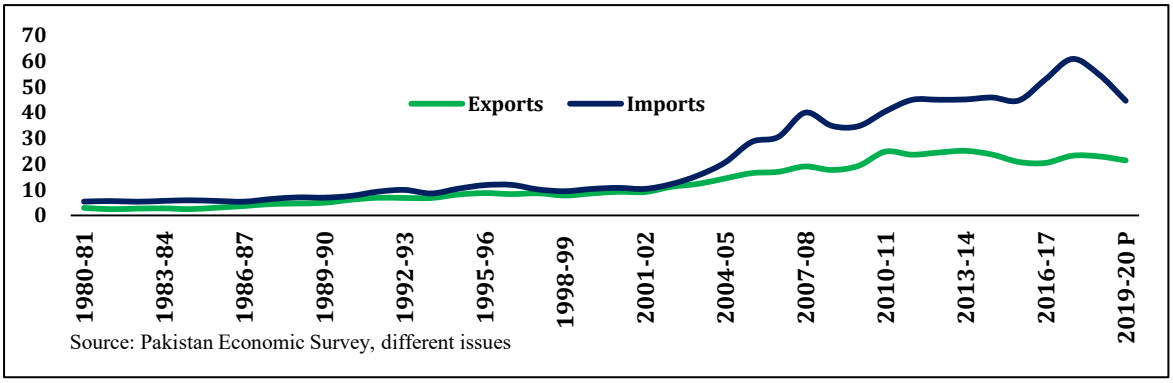


Source: Pakistan Economic Survey, Different Issues

However, it has been found that macroeconomic imbalances were exaggerated due to exchange rate misalignment and fluctuation along with its high volatility. International scenarios also constrained the economic performance of Pakistan as sometimes external factors remained critical. Further, Pakistan is considered an import-led economy. Historically, the widening trade deficit remained a critical problem to address as exports remained stagnant while there was a rising trend in imports, most of the time. However, after 2002-03, the trade deficit problem was exaggerated, as the services sector, especially consumer financing through easy loans, increased significantly in that era. Thus, aggregate demand is enhanced on account of high imports.

The other concerning fact is the structure of imports and exports. Historically, it has been observed that more than 85 percent of imports are related to production whether these are purely capital goods or raw materials to be used for capital goods or consumer goods. Contrary to this, the export structure revealed that during the 1980s to 1990s, 29 percent of exports were of primary goods. The following graph (Fig – 3.2) shows the performance of exports and imports from 1980 to 2020.

*Fig- 3.2: Export and Imports from 1980 to 2020 ($ billion)*



Source: Pakistan Economic Survey, different issues

However, a consistent average decline was observed after the 1980s and presently, 17 percent is the share of primary goods in exports. Regarding imports performance, it is mentionable that initially, the imports of raw materials were higher than consumer goods. The following tables 3a and 3b describe the structure of exports and imports for the last four decades:

**Table -3.1a: Structure of Exports and Imports (Rs. Million)**

| | | | 1990s | 2000s | 2010s | 2020s |
|---|---|---|---|---|---|---|
| **Exports** | **Primary Goods** | | 16,134 | 36,467 | 36,467 | 426,628 |
| | **Semi-Manufactured Goods** | | 10,176 | 55,228 | 55,228 | 304,737 |
| | **Manufactured Goods** | | 29,026 | 185,400 | 185,400 | 1,762,334 |
| | **Total** | | 55,335 | 277,094 | 277,094 | 2,493,699 |
| **Imports** | **Capital Goods** | | 28,047 | 111,602 | 427,592 | 1,463,946 |
| | **Raw materials for** | **Capital Goods** | 5,432 | 17,777 | 101,250 | 454,465 |
| | | **Consumer Goods** | 36,114 | 138,365 | 665,367 | 2,439,477 |
| | **Consumer Goods** | | 13,042 | 47,508 | 148,721 | 887,669 |
| | **Total** | | 82,636 | 315,252 | 1,342,930 | 5,245,557 |

Source: Pakistan Economic Survey, Different Issues

**Table -3.1b: Structure of Exports & Imports (%)**

| | | | 1990s | 2000s | 2010s | 2020s |
|---|---|---|---|---|---|---|
| **Exports** | **Primary Goods** | | 29 | 13 | 13 | 17 |
| | **Semi-Manufactured Goods** | | 18 | 20 | 20 | 12 |
| | **Manufactured Goods** | | 52 | 67 | 67 | 71 |
| **Imports** | **Capital Goods** | | 34 | 35 | 32 | 28 |
| | **Raw materials for** | **Capital Goods** | 7 | 6 | 8 | 9 |
| | | **Consumer Goods** | 44 | 44 | 50 | 47 |
| | **Consumer Goods** | | 15 | 15 | 10 | 16 |

Source: Pakistan Economic Survey, Different Issues

Moreover, in Pakistan, the aggregate supply side remained a binding constraint due to the productive capacity problem, Thus, the growth was usually driven from the demand side. It has been found that with structural weaknesses in terms of exports, higher growth is usually

accompanied by significantly higher imports. Further, the narrow domestically oriented industrial base, as well as the concentrated export basket, in which textiles and garments account for about half of all exports, remained some underlying structural vulnerabilities.

It is thus mentionable that in Pakistan macroeconomic policies, especially policies related to exchange rates always considered and focused on the import substitution model. However, sometimes, it also happened that the exchange rate remained undervalued to increase exports by avoiding uncertainty in market expectations. The assumption was that the undervalued currency might help the economy grow contrary to overvaluation which might hurt the growth of the economy. It is admissible that oil and machinery remained major commodities to be imported into Pakistan. Thus, international prices and scenarios played a significant role in external imbalances.

For the last ten years, the import composition of Pakistan revealed that imports have increased in every category particularly the machinery, petroleum group, and food group. Thus, it indicates that most of the products are intermediate goods that are used in industry and agriculture as well as the group wise import performance is presented in table 3.2 below. These products increased the productive capacity of Pakistan by helping in producing more agriculture and industrial products for domestic use as well as for exports.

**Table – 3.2: Group-wise Import Performance**

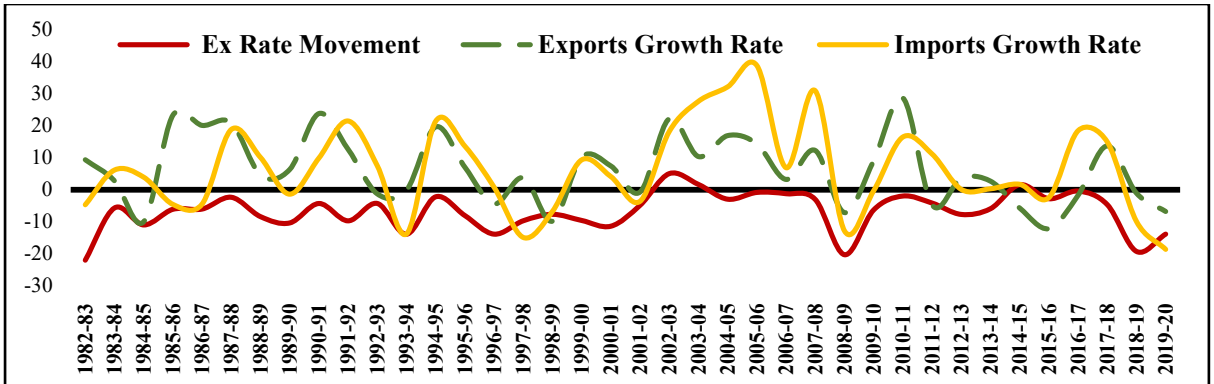
| % | Average Share | | | Average Growth | | |
|---|---|---|---|---|---|---|
| | 2009-2013 | 2014-2018 | 2019-2020 | 2009-2013 | 2014-2018 | 2019-2020 |
| **Food Group** | 11.1 | 10.8 | 12.2 | 1.7 | 8.3 | (4.3) |
| **Machinery Group** | 15.7 | 18.2 | 19.7 | -4.6 | 15.8 | (1.5) |
| **Transport Group** | 5.2 | 6.2 | 3.5 | 4.5 | 13.8 | (49.9) |
| **Petroleum Group** | 29.7 | 24.5 | 23.4 | 6.5 | 2.6 | (27.9) |
| **Textile Group** | 5.7 | 6.2 | 5.7 | 6.1 | 7.5 | (21.5) |
| **Agricultural & Other Chemical Group** | 15.5 | 15.3 | 16.5 | 2.6 | 7.1 | (16.0) |
| **Metal Group** | 6.9 | 8.3 | 9.1 | 5.2 | 10.5 | (18.4) |
| **Miscellaneous Group** | 2.0 | 2.2 | 1.8 | 4.0 | 9.1 | (21.0) |
| **All other Items** | 7.9 | 8.3 | 8.2 | 8.3 | 2.8 | (22.2) |
| **Total** | 100.0 | 100.0 | 100.0 | 2.8 | 6.6 | (18.6) |

Source: State Bank of Pakistan, Annual Reports, Different Issues

Almost 60 percent of the imports bill consists of Machinery (18 percent), Petroleum (26 percent), Agricultural and other chemicals (16 percent) Group. As Table – 3.2 shows the average share and growth of imports in different groups. 2019-20 is exceptional due to COVID-19 and some policy measures to restrict imports for addressing the BOP crisis.

Regarding the share in GDP, the share of exports in GDP usually remained around 8% while imports' share to GDP remained at about 20% as per National Account data. Since Pakistan is a developing nation, it made the transition from agrarian to industrial economics at a breakneck speed, shifting resources away from agriculture and into the service industry. As a result, services rather than commodity-producing industries like agriculture and manufacturing are increasingly driving the economy. While an increase in the services sector and reducing or stagnant the industrial sector did not confine the individual demand so an increase in demand for imported goods leads to an increase in the trade deficit. The opposite of it was also seen in some years as is evident from the graph shown in Fig 3.3.

***Fig 3.3: Relation between Growth Rate of Exchange rate Exports and Imports***

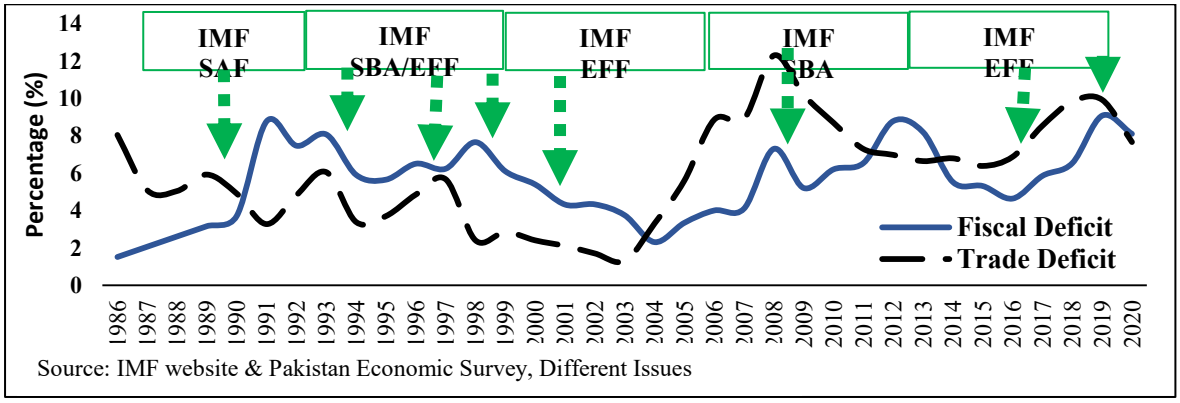



Source: SBP Annual Reports Different Issues

The poor performance of the external sector also intensified depleting foreign reserves thus putting pressure on the exchange rate. Thus, it amplified the financing need to tackle the trade deficit on account that the resources within the economy were not sufficient. Historically Pakistan's economy remained volatile. Further, heavy reliance on imports made external sector performance dismal. Irrespective of the causality of direction, it has been also

observed that in the years when the trade deficit was high, the fiscal deficit also remained high, compelling the evidence of a "twin deficit". Pakistan's trade deficit is mostly driven by fiscal imbalance. A straightforward time series plot of the trade deficit and the budget deficit from 1980 to 2020 demonstrates the positive link between the two variables. The following graph (Fig – 3.4) depicts that both deficits, trade, and fiscal move almost in a similar direction.

***Fig 3.4: Fiscal & Trade Deficit as % of GDP***



Source: IMF website & Pakistan Economic Survey, Different Issues

Further, historically, it was observed that Revenue to GDP remains low in Pakistan thus making internal financing constraints more rigid for financing budget deficit. Thus, the government was left with no option other than to sign IMF programs. Thus, the country since its membership has signed twenty-two loan programs with the IMF and the most recent in 2019. It has been observed that both deficits are usually contained, after entering the IMF program. The tax-to-GDP ratio is generally very low and there are strict constraints on the revenue side of the economy in Pakistan; however, to incur growth, the government increases spending, which raises aggregate demand and causes some of the additional aggregate demand to be met by increased imports.

It has been observed that each cycle usually consisted of three to four years of relatively stronger growth followed by a macroeconomic crisis leading to the negotiation of the IMF program with the objective of stabilized growth in the future. Historically, in Pakistan, it has been found that in past, failure to produce sustained and rapid economic

growth remained related to structural challenges and changing the exchange rate regime through fixed to managed and then floating exchange rates along with ineffective monetary and fiscal policies.

Further, every IMF program for Pakistan usually has two objectives; the first one is to bridge the revenues- expenditures gap to avert fiscal deficit from getting out of safe bounds and the second is to rebuild depleted foreign exchange reserves to avert the Balance of Payments (BOP) crisis. The analysis of Pakistan's affiliation with IMF shows twenty-two different fund facilities were availed but only three of them were fully utilized.

In the recent IMF program signed in 2019, IMF as one structural benchmark emphasized the autonomy of SBP. The reason is that every government was able to influence SBP somehow, which is supposed to make independent Monetary policy. In the context of Pakistan, because of financial illiteracy, the general public makes false illusions by linking an unchanged exchange rate to a stable exchange rate, though it might happen at the cost of burning foreign reserves.

Usually, a strong currency represents a strong economy, whereas a strong currency implies fewer fluctuations being slang used in Pakistan due to high illiteracy, especially in terms of finance. Even SBP which has the objective of monitoring misalignments, does not publish this information for the public to avoid chaos and uncertainty in the general public. Thus, the IMF's suggested remedial actions for external balances appear to be incomplete. External imbalances caused by our internal sector deficiencies will recur every five years. In Pakistan, the exchange rate variability led to macroeconomic imbalances either through ballooning current account deficit or widening of fiscal deficit, which not only hurt growth/ economic activity in the next episode but also adversely affected prices.

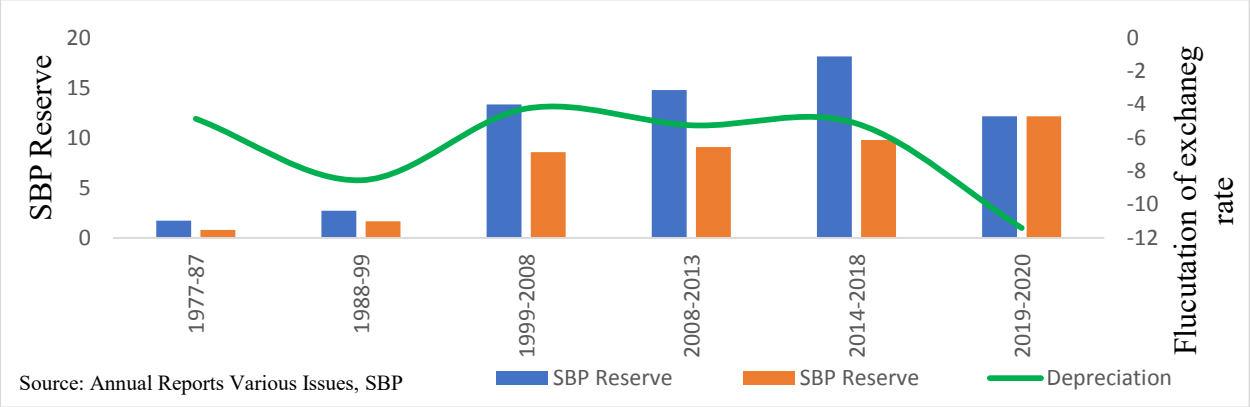
### 3.1. Historical Trend of Exchange Rate in Pakistan

In Pakistan, usually, the external sector faced imbalances because imports always remained significantly higher than exports. Further, the current account deficit was widened to a level unable to be financed by a financial account. Thus, making the government choose between devaluation or loss of foreign reserves. Most of the time, the government preferred to lose foreign reserves. However, market expectations were so weird that pressure on the Pakistani rupee remained always effective making it depreciate at the end. Thus, not only foreign reserves were lost but the exchange rate also depreciated. From 1980 to 2020, as per data used in the research, it has been found that on average exchange rate depreciated by 6.7 percent, with maximum depreciation of 20.3 percent occurring in 2008-09 and a minimum of 0.4 percent occurring in 2016-17.

However, in some periods, the exchange rate appreciated as well. On average it appreciated by 2.7, with a maximum appreciation of 5 percent occurring in 2002-03 and a minimum of 1.6 occurred in 2003-04. This evidence approach is based on a yearly average. However, the yearly average is considered as developing a biased and spurious relationship because high volatility within a month can smooth down on a yearly basis.

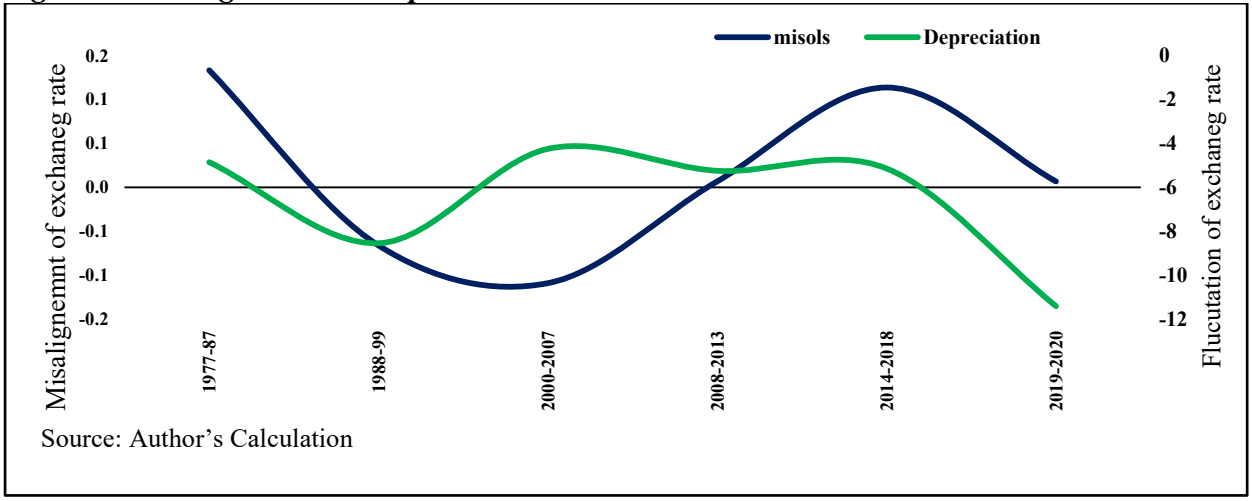
To find misalignments on evidence-based, it is argued that the level of SBP reserves a major role in exchange rate volatility/ fluctuations. Although the compilation of commercial bank foreign reserves started in FY1999 by SBP circular FE-25 on June 20, 1998. Before that, commercial banks were required to surrender foreign exchange to SBP. Thus, SBP reserves are the measure of reserve adequacy level, usually, reserve coverages of three months of imports are considered to be the threshold.

***Fig 3.5A: SBP Reserve & Exchange Rate Fluctuations***




Source: Annual Reports Various Issues, SBP

***Fig 3.5B: Misalignments & Depreciation***




Source: Author's Calculation

Analyzing Fig 3.5 A, it can be seen that although the governments were able to attain the certain highest level of foreign reserve for maintaining the nominal exchange rate at a desired value, the government ended by burning reserves by the end of their respective regime.

A significant example is the case of the regime 2014-2018, in which almost $6 billion in FY 2018 was burnt to maintain an exchange rate at 105 since June 2016. Thus, exchange rate management even in the floating exchange rate can be observed historically. Fig 3.5 B shows the misalignments of the exchange rate (misols) and along with the exchange rate fluctuation (depreciation). Thus, the relationship depicts that the misalignment of exchange rate and fluctuation of exchange had nonlinear pattern.

In order to have a deeper look into exchange rate dynamics historically, it was found that a fixed exchange rate regime was followed in Pakistan till the 1980s. From 1947 to April 1972, the exchange rate was fixed at around 1$ equal to Rs.4.77. However, it was devalued and remained at 11.00 Rs per dollar from May 1972 to Jan 1973. The government's decision of making it overvalued to 9.90 Rs against one dollar which remained at the same level till Dec 1981. However, after that floating exchange regime but managed was propagated to be in practice. The economic conditions which started impressively in the 1960s became dampened till the 1980s due to geopolitical conflicts like the Indo-Pak war and uncertainty in domestic politics due to the switching of the regime from democratic to authoritarian. Further, Afghan War brought an influx of capital inflows in terms of aid/donations. Thus, the economic conditions were able to bear the overvaluation of the exchange rate but to a certain time on account of the dynamics of the export and import structure in Pakistan.

The Pakistani rupee, thus depreciated by 51 percent and stood at 20 on average till 1990. It is mentioned that after the Afghan War and the imposition of Pressler sanctions in October 1990, the significant level of foreign aid was cut off. Further, during the decade performance of macroeconomic variables remained highly volatile with severe imbalances causing low growth and high inflationary pressures of that time, thus leading the exchange rate to depreciate by almost 63 percent reaching 51.7 Rs per dollar. Although trade expanded, inflation in Pakistan remained significantly higher than its main trading partners during the early1990s. Further, inflation remained unstable and on a rising trend during the whole decade. The period of 1999 to 2008 is considered again the period of authoritarian. However, the incidence of 9/11, spikes in foreign aid were recorded. Further, the economy also moved toward expansion with fewer macroeconomic imbalances and was more inclined toward services. All these factors contributed to the minimum depreciation of 17 percent. The exchange rate settled around 62.5 Rs against one dollar by the end of FY2008. With the start of the new political era, the depressed macroeconomic balances due to the foreign aid influx

started mounting again. Further, traces of the Asian financial crisis of 2008 are also being translated into Pakistan's economy. Thus, the performance of growth became subdued in FY2009, even though production of rice was recorded highest of that time (7 million tons). LSM growth became negative irrespective of the bumper crop of sugarcane in 2008. Thus, in Nov 2008, macroeconomic imbalances led Pakistan to seek assistance from the IMF, which at first depreciated currency by 20 percent and the exchange rate was 78.5 Rs per dollar.

After FY2009, the currency depreciated with an average of around 5 percent for this whole political regime while the exchange rate became 96.7 Rs against one dollar by end of FY2013. This is the period when the economy was suffering not only from the energy crisis but also from domestic security conditions were worst. These factors hindered capital inflows, especially through exports and foreign investment. However, the signing of the CPEC (China-Pakistan Economic Corridor) with China initially brought favorable macroeconomic conditions. Further new IMF program was initiated with a thrust of making Pakistan's economy sustainable in the long run. Initially, government policies aligned with IMF benchmarks put the economy on a higher growth path. It is mentionable that the higher growth momentum (5.5 %) observed in 2018, was unstable due to the high fiscal deficit along with the current account deficit.

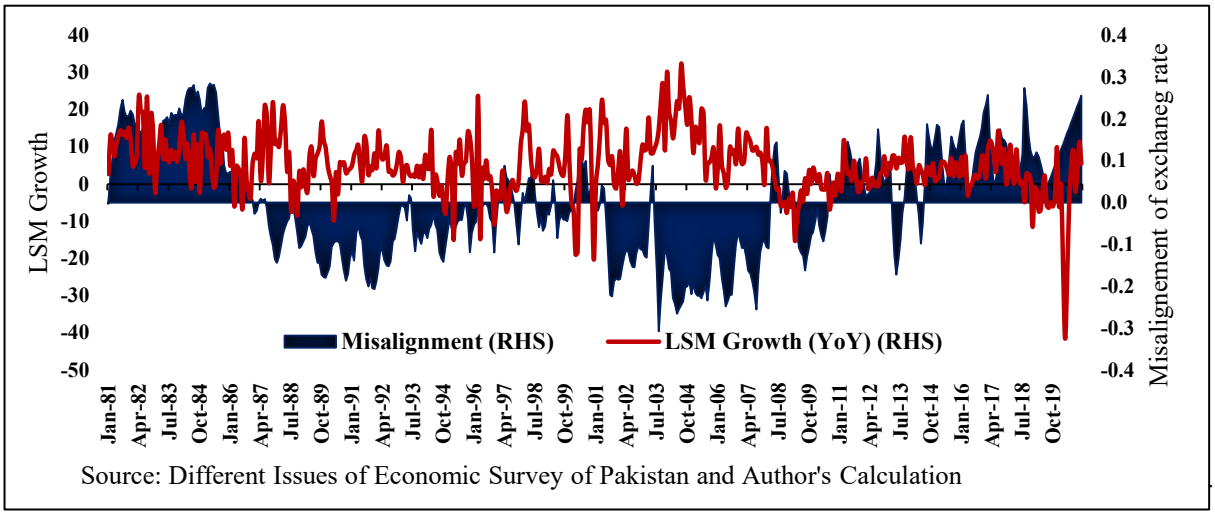
Historically, twin deficits always persisted in the economy with some degree of variation. Some of the requisite adjustments on fiscal accounts like the rise in energy and administrative prices were delayed due to the election year. Further maintained exchange rate resulted in severe macroeconomic imbalance through depletion of foreign reserves and increase in monetary borrowing. It is stated that a low inflation rate caused high consumption expenditure. Thus, a massive surge in imports was seen. To address growing imbalances, particularly in external accounts immediately, the exchange rate was realigned with market conditions. Thus, the Pakistani rupee depreciated against the dollar from Rs. 121.48 in 2018 to around Rs. 159.1 in Dec 2020.

### 3.2. Historically Trend of Exchange Rate Misalignment and Economic Activity

Historically, it has been observed that the GDP growth rate in Pakistan remained quite volatile. Further, the episodes of high growth have been accompanied by three significant disturbing factors: large fiscal and current account deficits, low savings and investment rates, and low human capital formation. Although the services sector accounts for about 60% of real GDP, the economy's development is still highly dependent on agriculture having interconnection with other sectors. Almost 60% of the industry is agricultural in nature, and agricultural commodities account for more than 40% of transportation and domestic trade. It is also stated that Large Scale Manufacturing (LSM) accounts for almost 75 % of Manufacturing, 47% of Industry, and 9% of real GDP. However, LSM performance is significantly dependent (almost 60 %) on two groups namely textiles and food, beverages, and tobacco. It is further mentioned that the performance of textiles is significantly dependent on cotton while the performance of food, beverages, and tobacco, the major contribution is from sugar extracted from sugarcane.

In the study LSMI (large-scale manufacturing index) was used as a proxy for economic activity. From the graphical representation shown in Fig 3.6, it is evident that there is usually a negative relationship between Economic Activity and exchange rate misalignments.

***Fig 3.6: Misalignments of exchange rate and Economic Activities (YoY)***




Source: Different Issues of Economic Survey of Pakistan and Author's Calculation

It has been observed historically that whenever misalignment remained negative, implying the prevailing exchange rate was less than its equilibrium value, positive growth in economic activity was observed. However, in the opposite scenario, economic activity performance remained mixed (high/low). It implied economic activity was also dependent on other macroeconomic variables. Like drop-in economic activity in Feb 2020 was due to the pandemic COVID-19.

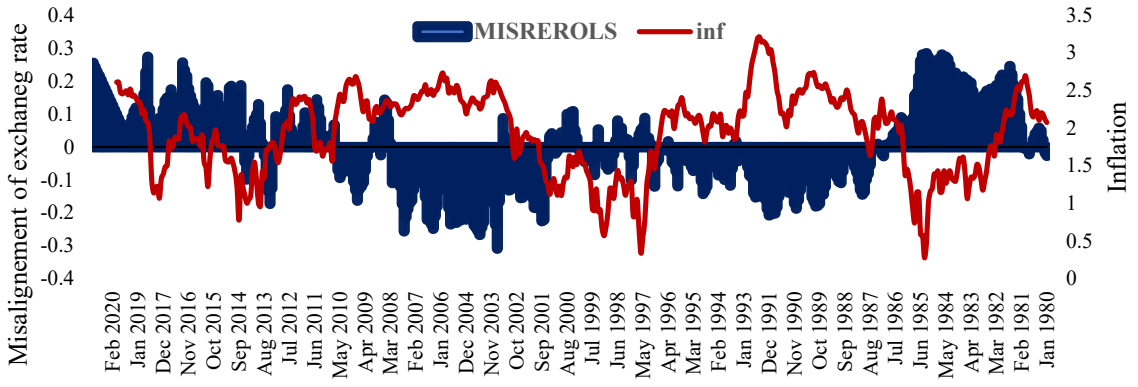
Further, the government was following a fixed exchange rate regime mainly to enhance exports till 1982. During the period, economic activity remained significantly positive but volatile. In the 1990s, devaluation in the exchange rate occurred by almost 53 percent compared to 1980 while, the Pakistani rupee remained misaligned and remained undervalued.

### 3.3 Historically Trend of Exchange Rate Misalignment and Prices

In Pakistan's economy, historically, significant rates of inflation were observed in different episodes of time, especially after 1971. Thus, for every government, controlling inflation remained the most notable concern. When an inflation shock occurs, its repercussions may last for an extended period because of the dynamics of rising prices. Further, downward revision seems to be rigid practically.

Many researchers attempted to examine the statistical features of inflation along with the causes of inflation. Thus, studies showed that inflation remains persistent, and economic behavior resists prices to reach manageable levels (Dargahi and Sharbat Oghli, 2010). In addition, inflation persistence has hampered monetary policy's ability to control inflation and has slowed the economy's reaction to monetary and fiscal policies. Similar to the literature regarding determinants of inflation for other economies, exchange rate misalignments, are also considered one of the determinants influencing inflation in Pakistan. Further, the persistent behavior of inflation was observed in an episode of continued misalignments.

***Fig 3.7 Misalignments of exchange rate and inflation (MoM)***




Source: Different Issues of Economic Survey of Pakistan and Author's Calculation

The relationship between inflation and misalignments of exchange rates shows that most of the time movement in the inflation rate remained opposed to the exchange rate misalignments. Till 1982, the government kept the exchange rate fixed mainly for enhancing exports. In that period, MoM inflation remained high while the exchange rate remained overvalued. However, overall, the relationship between the exchange rate misalignment and inflation usually remained negative. Increased production in different sectors and the growth of the money supply were also low during the 1980s. In 1990, the exchange rate devalued by almost 53 percent compared to 1980 which resulted in a high episode of inflation. The situation was exaggerated when in the late 1990s, there was an increase in food prices internationally. Nevertheless, after 1997, the exchange rate remained overvalued while the pace of inflation decelerated. This may be again due to an increase in production, strict budgetary measures, and low international prices. At the start of the 21$^{st}$ century, inflation was recorded at its lowest level in 2003. However, afterward, inflation started increasing, while the Pakistani rupee was maintained undervalued. In 2007, the exchange rate was 1$ is equal to Rs. 60, while inflation started increasing and reached its highest peak in 2008 ever seen between the period 1980 and 2020. This peak in inflation is also considered due to a significant rise in oil prices internationally. Further, high public and private spending also fueled domestic inflation.

Apart from these factors, monetary policy at the period aimed to contain inflation by raising interest rates to a large level, which pushed inflation further by increasing the opportunity cost of capital. Between 2007 and 2013, the country's massive current account deficits and terrorism exacerbated economic conditions, devaluing the rupee from Rs. 60 in 2007 to Rs. 101 in 2013, while inflation remained high. Variables such as import subsidies, a deficient export base, an energy crisis, and sluggish economic development have rendered the Pakistani rupee very unstable to the dollar. Specifically, during 2013-2018, it is found that Pakistani currency was overvalued as Rupee remained at Rs.101 and Rs.105, while inflation remained low. However, after 2018 inflation started increasing while the rupee started losing its value, thus, creating macroeconomic imbalances in the economy. The BOP crisis led the government to enter the IMF program and for its conditionality, a free-float regime was followed along with a reduction in import subsidies. This contributed to the depreciation of the Pakistani rupee which became around Rs. 158 in March 2020 compared to Rs. 121.48 in 2018.

Summarizing, it has been found that misaligned exchange rates resulted in macroeconomic imbalances which also adversely affected economic growth and domestic inflation. However, exchange rate fluctuation sometimes became beneficial and sometimes exaggerated the ongoing economic problems. Thus, there is a need to analyze the combination of exchange rate fluctuation and misalignment together to understand the impact of variation of exchange rate on macroeconomic variables, especially on economic activity and prices.

# Chapter 4

## Exchange Rate Fluctuations, Misalignments, and Uncertainty

### 4.1 Introduction

Understanding the relationship between equilibrium exchange rates and other macroeconomic variables is a constant topic of discussion in macroeconomics literature and policy implications. As mentioned earlier, the primary aim of this study is to examine how fluctuation, misalignment, and uncertainty in the exchange rate affect economic activity and price level. Thus, to achieve the desired objective, it is necessary to understand first the terms fluctuations, misalignment, and uncertainty in exchange rates. The variations in the exchange rate are usually considered of three types. One is fluctuations in the exchange rate, generally known as appreciation and depreciation. The second is misalignment which involves deviation of the exchange rate from its equilibrium level. Different methods exist in the literature for measuring exchange rate misalignment. The third variation in the exchange rate is uncertainty(volatility) which is the measurement through volatility model.

All these variations in the exchange rate affect the investment and consumption decisions of households and firms, which in turn impact macroeconomic variables. Within the realm of international macroeconomics, the study of currency exchange rates has continued to be the primary focus of researchers. The effect of exchange rate variation on macroeconomic variables has been studied extensively, however, most researchers have relied on exchange rate volatility or misalignment as their primary method. The terms "exchange rate fluctuation" and "misalignment of the exchange rate" are sometimes used interchangeably. However, in terms of impact and characteristics, these are different. Therefore, using these concepts separately in analyzing the impact on economic variables may give biased or inappropriate results, which may further mislead policy decisions.

The possibility of differentiating fluctuations in the exchange rate can be made by considering fluctuations converging toward the equilibrium (removing misalignment) and

diverging from equilibrium (widening misalignment). Therefore, it can be hypothesized that when the exchange rate fluctuations move toward the equilibrium, it will be beneficial for the economy, but when it moves away from the equilibrium value, it may be harmful to the economy. There is a research gap in the literature as fluctuations and misalignment was not used simultaneously. Also, uncertainty in the exchange rate affects the macroeconomic variables of the economy through the decision-making behaviour of individuals and firms. The more volatile the exchange rate market, the more challenging it is to plan for consumption and investment. Discussing fluctuation and misalignment of the exchange rate is highly requisite for making the combination of fluctuation and misalignment of the exchange rate.

The remainder of the chapter is organized as follows. Firstly, discussion of the fluctuation of the exchange rate. Then the concept of misalignment of the exchange rate is discussed in detail. Then theoretical framework followed by the econometric methodology will be discussed. After estimating the misalignment of the exchange rate, it will be combined fluctuation to make four scenarios that can be considered an extension of Shine et al., (2014) methodology of NARDL. In the last section, the measurement of exchange rate volatility is discussed.

This chapter will serve as a foundation for the study's remaining two objectives, which are to analyse the impact of changes in the exchange rate on economic activity and price level. Variations in exchange rates incorporate misalignment and fluctuation along with the exchange rate volatility.

**4.2 Fluctuations in the Exchange Rate**

Fluctuations in the exchange rate are generally known as appreciation and depreciation. However, as discussed earlier, the concept of a real effective exchange rate is used. There are changes in the real effective exchange rate, which are usually classified into appreciation (if $\Delta REER>0$) and depreciation (if $\Delta REER<0$).

## 4.3 **Misalignment of exchange rate**

Misalignment exists when the exchange rate deviates from its equilibrium value, while the misalignment is estimated by comparing the actual REER to its equilibrium value. The exchange rate is undervalued if the actual REER is less than the equilibrium REER and overvalued if the actual REER is above the equilibrium REER. As measuring the misalignment of the exchange rate is the main focus of this chapter, the theoretical framework of the equilibrium exchange rate is given below.

### 4.3.1 Theoretical Framework

Macroeconomic policymakers are more concerned about determining the equilibrium levels of exchange rates. The currency crises experienced by several emerging-market economies over the past decade are evidence of severe contraction in output and macroeconomic imbalances resulting from significant deviation of the exchange rate from its equilibrium level. Further, the exchange rate affects prices faced by consumers and producers around the world, and the results of significant misalignment can be extremely expensive. In addition, policymakers suggest that the misaligned exchange rate has a significant impact on all macroeconomic fundamentals, especially in low-income nations. Various methods have been developed by economists for determining equilibrium exchange rates. Each methodology entails theoretical simplifications and estimations of key parameters. It has been noted that the empirical estimates of equilibrium exchange rates derived from different methodologies may vary considerably. This makes it difficult to place a considerable measure of confidence in estimates derived from a single method alone.

Though in the literature, different models are available for determining the equilibrium value of exchange rates, however, in this research, Purchasing Power Parity (PPP) and Behavioral Equilibrium Exchange Rate (BEER) are used (Patnaik and Pauly, 2001; Chen and Macdonald, 2015). The assumption that real exchange rates should be relatively constant over time or that nominal exchange rates should fluctuate accordingly with

ratios of national price levels makes purchasing power parity (PPP) the method of choice for determining the equilibrium exchange rate. This assumption is consistent with the purchasing power parity (PPP) theory. It is also mentionable that non-tradable goods and services have lower prices than tradable ones in low-income countries (Hooper, 1978 and Banik, 2020). Thus, the PPP model has some limitations. Therefore, in literature emphasis (Clark and Macdonald, 1998; Comunale, 2019) has been given to Behavioral Equilibrium Exchange Rate (BEER) approach. It has been used by incorporating macroeconomic fundamentals to determine the equilibrium exchange rate. A detailed explanation of both approaches is given below:

#### 4.3.1.1 Purchasing Power Parity (PPP) Approach

Purchasing Power Parity (PPP) criterion is considered the first that determines exchange rate equilibrium by comparing buying power. Usually, it is considered a tool for comparing living standards across countries. Initially, this theory laid the groundwork for the interest rate parity model's development, which was later combined with the monetary and portfolio balance models. With extensive research and awareness of financial markets, the model begins to incorporate the factors that determine the exchange rate of the economy.

Purchasing Power Parity (PPP) Approach is considered a theoretical approach for calculating the equilibrium exchange rate. However, there are two criteria. One is relative PPP which was used initially to estimate the current equilibrium exchange rate. The other is the absolute PPP criterion. In any scenario, the equilibrium real exchange rate under PPP theory is constant, making it useful for comparing living standards.

Purchasing Power Parity (PPP) states a currency unit should buy the same number of products in all countries. As a country's inflation rate rises, its exchange rate must fall to retain PPP. Many economists conclude that in the long run, the PPP represents the forces that determine the exchange rate. Keynes (1923) estimates British, French, and Italian PPPs against the dollar for 1919-23. The dollar/pound comparison shows "the trend to concordance

between buying power parity and the currency rate," while in the case of France and Italy, results illustrate that "the Purchasing Power Parity Theory, even in its rudimentary form, has functioned sufficiently well.". A PPP approach was first adopted by Cassel,(1925) who estimate the misalignments in the case of the Swedish Krona and the pound of England. IMF, (1946) also used this method to compare the value of a currency with the PPP method against the dollar. Houthakker, (1962) used this method to compare the dollar and mark. The method of PPP used for the calculation of misalignment is as follows:

$eqex\_ppp = (p^{pk}/p^{usa}).exc$

$p^{pk}$ is used as the price index of Pakistan.

$p^{usa}$ is used as the price index of the USA.

$exc$ used as the exchange rate of the (1$ = Pak Rs) Pakistani rupee with the dollar as Pak rupee per US dollar i.e., PKRs/ US$.

Economists can calculate exchange rates by comparing the purchasing power of different currencies under the assumption that the Relative PPP holds. However, it is important to note that many factors, such as trade barriers, transaction costs, non-tradable goods, government interventions, market expectations, and various economic shocks, can deviate from this assumption. These variables can cause deviations from predicted exchange rates based on Relative PPP. As a result, while Relative PPP is an important concept, it should be regarded as a theoretical benchmark rather than an accurate predictor of actual exchange rates Therefore we used the second method to calculate the equilibrium exchange rate that is known as BEER.

#### 4.3.1.2 Behavioral Equilibrium Exchange Rate (BEER) Approach

Clark and MacDonald, (1998, 2000) introduce the BEER approach which is the modified version of the Fundamental Equilibrium Exchange Rate (FEER) approach. The FEER approach was developed by IMF, (1970). It is defined as evaluating exchange rate

misalignments in the context of achieving medium-term macroeconomic equilibrium in the economy, which includes both domestic and external balance. The BEER approach focuses on the macroeconomic fundamental determinants of the real exchange rate. The approach was devised to solve the PPP and FEER issues. The reason is that the performance of economic variables also influences the equilibrium exchange rate which was missing in the earlier two approaches. Thus, the misalignment found by this method varies from country to country on account of differences in macroeconomic variables and their respective impact on the overall economy. Economic fundamentals play a vital role in determining the value of the equilibrium exchange rate. This approach estimates the equilibrium exchange rate using current values of fundamentals including net foreign assets, terms of trade, government consumption, government investment, and interest rate differentials.

In the literature, Net Foreign Assets (NFA) is used as a proxy for capital inflows (Edwards,1989). The reason is that an increase in capital flows will increase total assets, which in turn will appreciate the domestic currency. Further, the relationship between international payments and the real exchange rate—what economists refer to as the transfer problem—is a major issue in international economics. Due to the significant component of non-tradable products in domestic GDP, a real exchange rate increase diminishes the absolute value of NFA denominated in the foreign currency relative to domestic GDP. Therefore, NFA is an important variable in the analysis of the equilibrium exchange rate.

Similarly, terms of trade have been employed because they are likewise related to external balance. When terms of trade deteriorate, it puts pressure on a domestic currency, forcing the exchange rate to depreciate, which may result in related imbalances. Terms of trade are also used as an important determinant of the Equilibrium Exchange rate. The reason is that there exists a strong relationship between net exports and terms of trade and thus any

terms-of-trade shock can cause depreciation or appreciation of REER through net exports. This makes it vulnerable to severe market changes and shocks.

Government Consumption and Investment are important determinants of aggregate demand, especially in the context of Pakistan's economy which has become the primary cause of internal and external imbalances and hence a crucial variable in determining the macroeconomic fundamentals of Pakistan. Devaluation of a country's currency activates the "expenditure switching" process, which shifts domestic demand away from imports and toward locally produced import-competing commodities. It also boosts exports by improving international competitiveness. Literature has shown that in some countries, relative Government Consumption is one of the important determining factors in the assessment of the Equilibrium Real Effective Exchange Rate (Bussière et al., 2010 Lee et al., 2006). The underlying theoretical reasoning is that higher or increasing Government Consumption is likely to concentrate on expenditure for non-traded goods and services, rather than on tradable ones. This would raise the relative price of non-tradable and therefore appreciate the REER (Ostry, 1994; Badia and Segura, 2014 De Gregorio and Wolf, 1994). This would hurt the country's competitiveness. So, government consumption is an important variable in discussing the equilibrium exchange rate.

The relationship between the exchange rate and economic activity is determined by changes in government investment, which affect both the domestic and international markets. Changes in government investment decisions as a result of changes in the cost of imported intermediate goods and the user cost of capital may amplify the impact. Literature has shown that the relationship between Government Investment and the REER is ambiguous depending upon its effects on productivity in tradable and non-tradable sectors. The REER will appreciate it if the level of productivity in the tradable sector is raised more by the government investment, while it may depreciate if the productivity level is increased more in

the non-tradable sector. Similarly, there would be no effect on REER if productivity is equally enhanced in both sectors symmetrically (Chatterjee and Mursagulov,2012). Galstyn, (2009) showed that an increase in government investment results in an appreciation of the real exchange rates and a considerable increase in consumption in developing countries.

Finally, the Interest Rate Differential is used as a proxy for the opportunity cost for investment, especially foreign investment, and hence it can also be linked with capital inflows. When comparing two equivalent interest-bearing assets from two different nations, the interest rate differential is taken into account. Higher interest rates in the domestic country relative to other countries provide a greater return for lenders. Therefore, higher interest rates attract foreign capital and cause a rise in the exchange rate. Thus, it is likely that foreign capital will be placed in the domestic bank. Therefore, if domestic interest rates rise, investors with a short-term horizon will increase their demand for the domestic currency. It will result in an appreciation in its exchange rate. Keeping other things, the same, the real exchange rate will depreciate. However, the impact of an increased interest rate is lessened if inflation in the country is substantially higher than in the rest of the world, or if other factors contribute to the currency's depreciation. Thus, interest rate differential is also an important variable in discussing equilibrium exchange rates.

#### 4.3.1.2.1 Empirical Methodology

To find the equilibrium exchange rate through the BEER approach this study uses variables and steps as followed in the literature (see for instance, Aguirre and Calderon, 2005; Hyder and Mehboob, 2005; Sallenave, 2010; MacDonald and Vieira, 2010; Abida, 2011). The steps followed in this method are:

**(i)** Considering Net Foreign Assets, Terms of Trade, Government Consumption, Government Investment, and Interest Rate Differential as fundamental drivers

of the Equilibrium Exchange Rate, the Real Effective Exchange Rate (REER) is regressed on these drivers.

(ii) Equilibrium REER is estimated by using the estimated coefficients from the first step and then using permanent components of the REER.

(iii) Differences between the equilibrium real exchange rate and the observed real exchange rate are used to determine the misalignment of the exchange rate.

Using these steps, the task is to estimate the equilibrium exchange rate. For that, different methodologies are applied to estimate the equilibrium exchange rate. In this study, two models are estimated; the first one is the simple regression framework while the second is the ARDL model. The two models are explained in detail below.

***a)*** **Simple regression framework**

In pursuance of mentioned steps, the following model is adopted from Berg and Miao (2010), Naseem et al., (2013); Conrad and Jagessar, (2018), which is estimated including both domestic as well as external factors determining equilibrium exchange rate as shown in equation (4.1).

$$REER_t = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\, nfa_t + \boldsymbol{\beta_2}\, tot_t + \boldsymbol{\beta_3}\, govcon_t + \boldsymbol{\beta_4}\, govinves_t + \boldsymbol{\beta_5}\, idiff_t + \epsilon_t \quad (\mathbf{4.1})$$

REER denotes the log of real effective exchange rate, NFA denotes net foreign assets, tot denotes terms of trade, govcons denotes government consumption, govinves denotes government investment, and idiff denotes interest rate differential.

Thus, by estimating equilibrium REER, any deviation from the equilibrium REER will be called misalignment.

Least squares are commonly known as ordinary least squares (OLS) because it was the first-ever statistical procedure to be developed (circa, 1800). Hyder and Grossmann et al., (2014) using macroeconomic fundamentals estimated misalignments of the exchange rate by applying the OLS method. The term "ordinary" was added to "least squares" only after so

many alternative methods arose that the (still most) popular OLS needed to be differentiated from the plethora of other minimizations that became available. Linear regression refers to any approach to modeling a linear relationship between one or more variables. The goal is to minimize the differences between the collected observations in some arbitrary datasets and the responses predicted by the linear approximation of the data. This method helps to distinguish between the role of different variables and their coefficients are easily interpretable. Therefore, the first method used for estimation of the equation is by simple least square framework while misalignment is measured by equation (4.2)

$$\text{mis}_t = \text{REER}_t - \widehat{\text{REER}}_t \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4.2)$$

Here $\widehat{REER}_t$ denotes the estimated REER (equilibrium real exchange rate) and REER denotes the log of Real Effective Exchange Rate, whereas *mis* denote the exchange rate misalignment. Thus mis> 0 will be considered overvalued exchange rate and conversely, mis< 0 will be considered undervalued.

It is mentionable that estimated results from a simple regression framework are considered biased and inconsistent when variables are nonstationary and non-cointegrated or if there exists endogeneity. Thus, there is a need to check whether these variables are cointegrated or not. In econometrics, two variables are said to be cointegrated if they are shown to be in a state of long-term equilibrium together. The unit root test and the cointegration test are not the same things. Because single time series are used in unit root testing. Cointegration, on the other hand, examines the interrelationship of several variables, all of which (under certain assumptions) have unit roots. If two or more time series are cointegrated, it's because they have an equilibrium connection over the long term. We adopted the ARDL because it is the most appropriate method for examining a long-term relationship. Thus, the ARDL model provides unbiased estimates and valuable statistics, irrespective of some regressors having different orders of integration of variables.

**b) ARDL Model:**

An ARDL is a least-squares regression that contains lags of both dependent and independent variables. ARDL is usually denoted with the notation ARDL $(p, q_1, \dots, q_k)$, where $p$ is the number of lags of the dependent variable, $q_1$ is the number of lags of the first explanatory variable, and $q_k$ is the number of lags of the $k^{th}$explanatory variable. ARDL is a linear time series model, which is a general form that can be written as follows:

$$REER_t = \alpha + \sum_{i=1}^{n} \beta_i REER_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{qj} \gamma_{ij} x_{j,t-1} + \varepsilon_t \quad \dots\dots (4.3)$$

$REER_t$ is the dependent variable whereas $\gamma_t \dots\dots\dots\dots\dots\dots \gamma_k$ show the coefficients of independent variables. $\beta_i$ shows the coefficient of the lagged REER. The important step is to determine the lag length of dependent and independent variables as it is a prerequisite. This model gives the short-run and long-run relationship among explanatory and response variables. REER was estimated with both long-run and short-run variation.

**Bound test**

Pesaran et al., (2001) have developed a Bounds test to test whether the ARDL model contains a long-run relationship between dependent and explanatory variables. The Bounds test procedure converts the cointegrating equation (4.3) into the following form:

$$\Delta \mathrm{REER}_t = \alpha_1 + \beta_1 t + \gamma \mathrm{REER}_{(t-1)} + \sum_{j=1}^{k} \eta_j x_{j,t-1} + \sum_{i=1}^{p} \gamma_j \Delta \mathrm{REER}_{j,t-i} + \sum_{j}^{k} \sum_{l=0}^{q_{j-1}} \gamma_{j,l} \Delta x_{j,t-l} + \sum_{j=1}^{k} \omega_j \Delta x_{j,t} + \varepsilon_t \dots (4.4)$$

$Where\ x_t = [nfa, tot, idiff, govcon, govinv\ ]\ is\ vector\ of\ explanatry\ variables$

The test that whether or not there exist relationships at the level is simply the test of

$$H_0: \gamma = \eta_1 = \eta_2 = \eta_3 = \dots = \eta_k$$

$$H_1: \gamma \neq \eta_1 \neq \eta_2 \neq \eta_3 \neq \dots \neq \eta_k$$

The coefficient estimates used in the test may be obtained from a regression using (4.1) or can be estimated directly from a regression using (4.4).

Analyzing the unit roots is necessary before conducting a cointegration analysis. It was found that the variables are I (1) or I (0). The existence of a characteristic root equal to one is referred to as a unit root. The AR is the simplest model that can have a unit root. Where the uncorrected white noise error term mentioned in equation 4.4 has a mean of zero and a constant variance. The Augmented Dickey-Fuller Test is used to answer this question (ADF). The ADF test is a lower tail test; if its value is smaller than the critical value, the null hypothesis of the unit root is rejected, and the conclusion is that the variable does not contain a unit root and it is stationary. The results of this study show that the variables were found mixture of stationary and nonstationary variables (results are presented in ***Appendix B***). Therefore, the resultant equation can be given as:

$$\Delta REER_t = \eta_0 + \sum_{j=1}^{p} \eta_{1i} \Delta REER_{(t-j)} + \sum_{i=0}^{q} \eta_{2i} \Delta nfa_{(t-i)} + \sum_{i=0}^{q} \eta_{3i} \Delta tot_{(t-i)} + \sum_{i=0}^{q} \eta_{4i} \Delta \mathrm{i} diff_{(t-i)} + \sum_{i=0}^{q} \eta_{5i} \Delta govcon_{(t-i)}$$

$$+ \sum_{i=0}^{q} \eta_{6i} \Delta govinves_{(t-i)} + \lambda_1 nfa_t + \lambda_2 tot_t + \lambda_3 diff_t + \lambda_4 govcon_t + \lambda_5 govinves_t + \mu_t \ldots\ldots (4.5)$$

Here estimated $REER_t$ is used for the equilibrium exchange rate while REER is the actual Real Effective Exchange rate. Equation (4.5) shows the specification which gives both short-run and long-run coefficients. λ represents long-run coefficients while coefficients (η) attached to the differenced variables depict short-run coefficients. Though error correction term, and its coefficient shows the speed of convergence to long-run equilibrium. After estimating the equilibrium exchange rate, equation (4.2) has been used to estimate the misalignment of the exchange rate.

#### 4.3.1.2.2 Description of Variables

The variables used in the analysis are Net Foreign Assets, Terms of Trade, Government Consumption, Government Investment, and Interest Rate differential. It is also

mentionable that Log is applied for scale invariance in situations of self-similarity. Thus, the Log of Net Foreign Assets, Government Consumption, and Government Investment is taken as the magnitude of these variables is mainly different from Terms of Trade and Interest Rate Differentials which are in percentages. It is mentionable that the variables available on low frequency (annual or quarter) were converted into high frequency (monthly) by linear, Litterman, and Chow-Lin methods. Each value in the low-frequency series is matched with either the first or last high-frequency observation corresponding to the low-frequency period, and all intermediate values are shown along straight lines between these two points. Nonstationary series can be analyzed using the Litterman method, which treats the series as a Random Walk, while stationary series require the Chow-Lin approach. This method is regression-based interpolation relating one or more high-frequency target series to the low-frequency series and assumes the series is AR (1) process).

**Net Foreign Assets (NFA):** Net Foreign Assets (NFA) is a component of factors affecting broad Money (M2) whereas M2 is one of the methods used to measure the money supply. On the asset side, however, M2 is the total of the banking system's net domestic and net foreign assets (i.e., SBP and scheduled banks). NFA is published on weekly basis by SBP in the data on Monetary Aggregates as both stock (measurable at a particular point of time) and flow (measured with reference to a period) variable and is mentioned in million rupees. The data is monthly, so flow variable value was added into Jan 1980 NFA stock to get monthly NFA stock. Further log of NFA was used being a convenient way to express large numbers.

**Terms of Trade:** The terms of trade (TOT) reflect the ratio between the export value of a country and its import value. Terms of Trade are published by PBS on an annual and quarterly basis but the base year available is 1990-91=100. To harmonize it with other variables which mostly were on base year 2010=100, the base of Terms of Trade was converted to 2009-10=100 by the splicing method. The quarterly values were then split into

monthly values by using the Litterman method applied to nonstationary series and the method assumed the series as Random Walk.

**Government Consumption:** Ministry of Finance published fiscal operation data quarterly mentioning fiscal details both at the Federal and Provincial levels. For Government Consumption, consolidated Current Expenditure both at the Federal and Provincial levels has been used. The value of current expenditure is measured in Rs million, thus for convenience, log of current expenditures is taken. Further to convert the quarterly values into monthly values, the Linear method was used which is available in EViews as discussed earlier.

**Government Investment:** For Government Investment we used total development expenditure which is the sum of development expenditure at the federal and provincial. It is also expressed in million rupees. Thus, the log was taken, and the linear method was applied as done in the case of government consumption.

**Interest Rate Differentials:** When comparing two equivalent interest-bearing assets from two different nations, the interest rate differential is taken into account. In the present study, interest rate differential is taken as the difference between interest rates in the United States and Pakistan. For both the United States and Pakistan, the call money rate is used. The data is available on a monthly frequency.

**Exchange rate:** The exchange rate is defined as the value of the currency of the domestic country in terms of the currency of another country. In this study, the exchange rate (1$ = Pak Rs) Pakistani rupee with the dollar or Pak rupee per US dollar i.e., PKRs/ US$ was used. The fluctuation in the exchange rate fluctuation was calculated as $(\frac{ER_t}{ER_{t-1}} - 1) \times 100$. Thus, the positive values indicate appreciation while negative values indicate depreciation in the exchange rate. Further details of all variables are available in ***Appendix C.***

#### 4.3.1.2.3 Data Span and Sources

The monthly data set for all variables have been used for the analysis in this study which ranges from 1980 to 2020. As discussed above, in this chapter, the explanatory variables for estimating misalignment are interest rate differentials, Net Foreign Assets, Government consumption Expenditure, Government investment Expenditure, and Terms of trade. Data on REER, Net Foreign Assets, and Terms of trade have been obtained from the State of Pakistan Annual Reports and Pakistan Bureau of Statistics Publications. Data regarding the Government's Current Expenditure and Government Development Expenditure have been obtained from different issues of the Pakistan Economic Survey, a publication of the Ministry of Finance. Finally, data on interest rate differentials have been obtained from International Financial Statistics (IFS), a publication of IMF.

#### 4.3.1.2.4 Results and Discussion

In this research, Purchasing Power Parity (PPP) and Behavioral Equilibrium Exchange Rate (BEER) methods have been used for determining equilibrium exchange rates. Further, misalignment has been estimated with a simple regression framework as well as in the ARDL model. The results estimated by each model are discussed below.

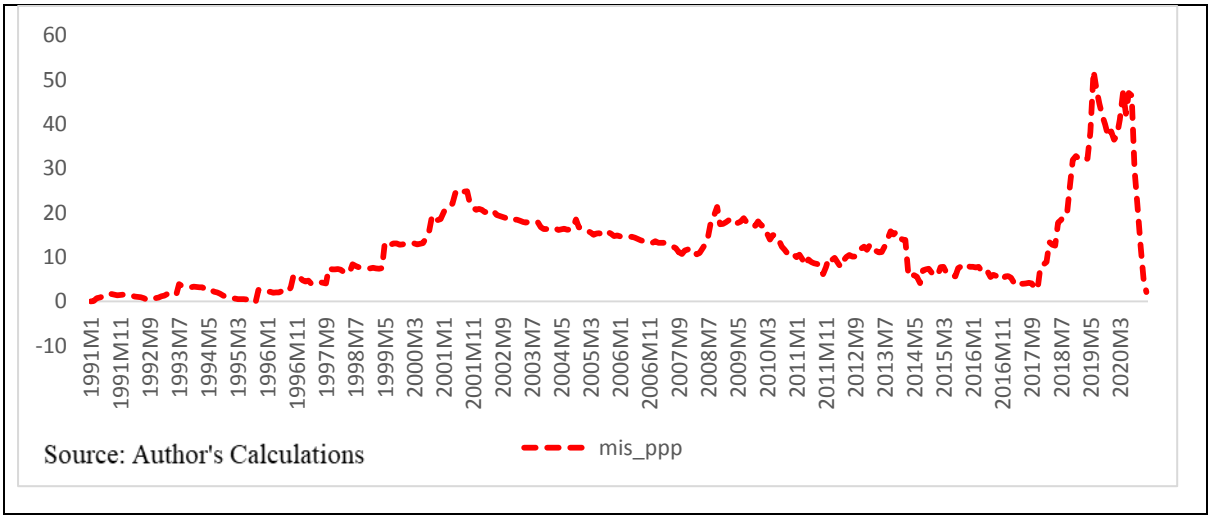
a) **Results based on Purchasing Power Parity (PPP) Model**

In research, the relative PPP theory has been used to measure the misalignment of the exchange rate in the case of Pakistan, and it has been found that mainly the exchange rate remained misaligned. The results showed that the exchange rate usually remained overvalued in Pakistan, implying that it remained away from the equilibrium value. The misalignment result is given in Figure 4.1. The result is consistent with Hussain (2008), who found that the exchange rate was overvalued from 1970 to 1978, comparatively close to equilibrium from 1978 to 1988, and again remained overvalued from 1989 to 1999. Notably, the intensity of divergence increased after 1999 and remained extended till 2001. After 2001, the exchange rate started coming back to its equilibrium value. Nevertheless, it remained misaligned and

overvalued till 2008. After 2008, the exchange rate started diverging away from its equilibrium value. Thus, it remained significantly overvalued till 2010.

Further, it starts to move towards an equilibrium but divergent till 2011 but it start increasing divergent and overvalued till 2013. At the start of 2014, misalignment started squeezing and became minimum during 2017. while it again increased significantly by the end of 2017the divergent increase with time. In 2018, the newly elected government started trying to negotiate the IMF program as the economy was under pressure due to internal and external macroeconomic imbalances, and the foreign reserve was very much below its requisite adequacy level. On July 3, 2019, the Executive Board of the International Monetary Fund (IMF) approved a 39-month extended arrangement under the Extended Fund Facility (EFF) for Pakistan. After the IMF program, the exchange rate depreciated significantly. Another condition of the program was to make the exchange rate market based. Thus, misalignment in the exchange rate started declining by the end of 2020.

***Fig 4.1: Exchange rate misalignments by PPP***




PPP exchange rate is more stable and is a better measure for comparison of living standards and overall well-being of the economies as it helps to account for the differences in prices of goods and services among countries especially emerging and developing economies (Callen 2020). But the misalignments calculated by PPP are not linked with macroeconomic dynamics that happened during the time. Further, it is unable to address the direction of

movement of CPI from the USA to Pakistan or otherwise. Therefore, the PPP exchange rate is often incompatible with macroeconomic equilibrium. Therefore, to address the drawbacks of PPP, the recent BEER approach is used to estimate the equilibrium exchange rate.

**b) Results of the Behavioral Equilibrium Exchange Rate (BEER) approach**

1) **Estimation in Simple Regression Framework**

The estimated results of the Simple Regression Framework are shown in Table-4.1. It is mentionable that all variables are found significant. However, the direction of impact on the exchange rate is different. Term of trade, net foreign assets, and government investment positively and significantly affect the real effective exchange rate while government current expenditure and interest rate differential negatively and significantly affect the real effective exchange rate. The estimated results are similar to the earlier research done in this context (Aguirre and Calderon, 2005; Hyder and Mehboob, 2005; Sallenave, 2010; MacDonald and Vieira, 2010; Abida, 2011).

**Table-4.1 Results of Simple Regression Framework**

| Variable | Coefficient | P-value . |
|---|---|---|
| **TOT** | 0.151 | 0.009 |
| **NFA** | 0.032 | 0.014 |
| **GOVINVES** | 0.238 | 0.000 |
| **GOVCON** | -0.330 | 0.000 |
| **IDIFF** | 0.005 | 0.007 |
| **C** | 4.483 | 0.000 |
| **R-squared** | 0.755 | |
| **Adjusted R-squared** | 0.752 | |
| **S.E. of regression** | 0.130 | |
| **Durbin-Watson stat** | 0.083 | |

Dependent Variable: REER
Source: Author's Estimation

The result showed that NFA is positively linked with REER. Increase in NFA strength the BOP. According to the literature, NFA gives a reflection of the country's overall Balance of Payments (BOP) position over time. Higher (lower) NFA are expected to appreciate (depreciate) the REER (Lee et al., 2006; Badia and Segura, 2014).

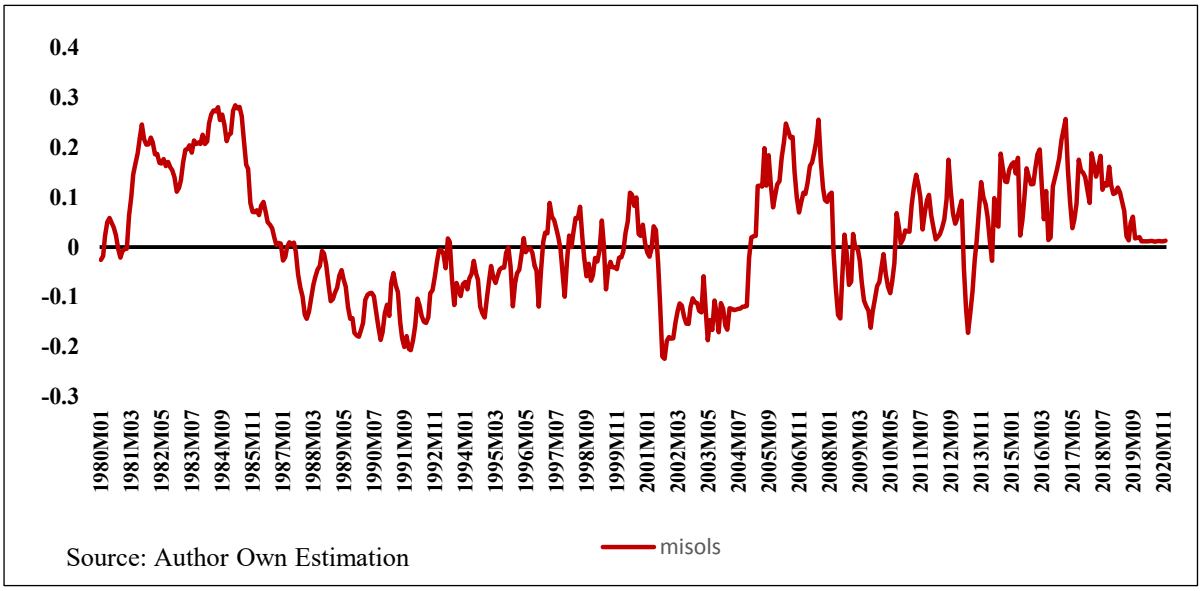
Terms of trade are also positively linked with the REER. As the terms of trade, which are related to the severity of trade restriction become a crucial factor affecting the exchange rate. Increased import tariffs and non-tariff trade obstacles may shield domestically produced commodities from foreign competition, resulting in higher domestic pricing and hence in appreciation of real effective exchange rate (Bussière et al., 2010) and (Lee et al., 2006). However, deteriorating terms of trade may adversely affect the current account balance. Thus, REER may depreciate.

Government consumption is negatively linked with the REER. So, if there is an increase in Government Consumption, it would lead to the depreciation of real effective exchange rates. In the literature, Government Consumption is considered a significant determinant of the Real Effective Exchange Rate in several countries (Bussière et al., 2010 Lee et al., 2006). The underlying theoretical argument is based on the fact that a rising trend in Government Consumption is likely to focus on non-traded products and services rather than tradable ones, given the nature of government consumption. Thus, an increase in government consumption will increase the relative value of tradable, hence appreciating the real effective exchange rate (Badia and Segura, 2014, De Gregorio and Wolf, 1994).

Government investment is positively linked with a real effective exchange rate. An increase in government investment would lead to the appreciation of the REER. An increase in investment stimulates the demand through the effect of the user cost of capital and imports of goods both for domestic goods and imported goods which eventually affect the export and imports of the economy. The increase in exports due to increased government investment and foreign reserves led to an appreciation of the REER. This would have a detrimental effect on the country's competitiveness. Finally, results show that the interest rate differential also negatively affects the exchange rate. The reason for this is that higher domestic interest rates attract international capital, which causes the real exchange rate to appreciate. (Hoffmann and Macdonald, 2009).

Furthermore, the results show that misalignment found by simple regression in the BEER framework has also been observed that misalignment followed consistent fluctuations with some episodes of overvaluation and some episodes of undervaluation were found with fluctuation of appreciation and depreciation and correction in misalignment observed for the short period. However, the intensity of misalignment remained volatile as shown in Fig 4.2.

**F*ig 4.2: Misalignments by Simple Regression Framework***




Source: Author Own Estimation

In the BEER model, the equilibrium exchange rate is decided based on the economic state of the country at some time. The results found in this study are almost similar to the results found by Hussain, (2009) which identified the sources of misalignment. He reported that the major factors behind misalignment are capital inflows and increased public expenditures. There are clear episodes of over and undervaluation. One possible reason for overvaluation is that most of the time the State Bank of Pakistan has foreign reserves more than adequacy level, the exchange rate can be managed overvalued. And the time of undervaluation is due to the IMF programs in each program being taken under the pressure of macroeconomic imbalances. Therefore, the exchange rate depreciated in all of the IMF programs signed for bringing macroeconomic stability to the country, especially through addressing external sector vulnerabilities. After the end of the IMF program, the value of

currency again remained overvalued. The intention of keeping overvalued exchange rates is related to the belief that a strong currency showed a strong economy. Thus, it was done primarily to restore the confidence of the general people, which focuses exclusively on the movement of the nominal exchange rate and associates it with the strength of the government. The currency remained overvalued until the economy was again trapped in macroeconomic imbalances leading to a new IMF program.

**2) Estimation in ARDL Model**:

The bound test results show the presence of cointegration among variables of the BEER model. The results of the bound tests are shown in table 4.2. The bound test value is 3.464 which is greater than the lower bound and upper bound at an even 5% significant level which implies that there is a long-run relationship between variables.

**Table 4.2 Bounds test**

| **F-Bounds Test** | | **Null Hypothesis: No levels of relationship** | | |
|---|---|---|---|---|
| **Test Statistic** | **Value** | **Signif.** | **I(0)** | **I(1)** |
| **F-statistic** | 3.464 | 10% | 1.99 | 2.94 |
| **K** | 6 | 5% | 2.27 | 3.28 |

The results of short and long-run estimates are presented in table 4.3. The short-run results show that REER is highly significantly affected by its lag values. The interest rate differential, terms of trade, NFA, and government investment impact REER positively. Results further demonstrate that current consumption affects significantly and negatively. Thus, aligned with existing literature (Jongwanich, 2009), our finding supported the fact that the severity of trade restriction is a crucial factor in determining the equilibrium exchange rate. Thus, as found by Mendoza, 1995, the worsened terms of trade cause higher domestic pricing and hence the depreciation of the real effective exchange rate. Likewise, similar to the findings Mano, 2019, improvement in NFA appreciated the REER. Similarly, an increase in government investment positively affects productivity in tradable and thus REER appreciates similar to the findings of Hyder, 2005. However, for Pakistan increase in Government

Consumption appeared to be a more significant determinant of the Real Effective Exchange Rate. The rising trend in Government Consumption has focused on non-traded products and services rather than tradable ones, thus, causing a detrimental effect on the country's competitiveness. Finally, a higher interest rate differential attracts international capital, which causes the real exchange rate to appreciate or the nominal exchange rate to depreciate.

ECM coefficient reflects that every time there are some fractions of error in equilibrium, which is corrected by the dependent variable whenever it gets closer to a long-run relationship. ECM can be used to explain the series' short-run dynamics. It denotes the speed of the adjustment coefficient, which indicates how rapidly the series converges to the long-run equilibrium. Every time certain fractions of the dependent variable's imbalance are adjusted which then moves closer to a long-run relationship.

The results of the model estimation are provided in table 4.3. The value of the coefficient of the error correction model is negative 0.923 which shows the high speed of adjustment towards the equilibrium value, and it is statistically significant. The results show that in the short run, deviations from our long-run equilibrium are corrected at roughly 92% every month.

***Long-run result***

The long-run results show that net foreign assets, interest rate differential and government investment are positively affecting the real effective exchange rate. However, the government's current expenditure is significant and negatively affects the real effective exchange rate. Thus, similar to earlier literature (Galstyan, 2009; Helbling and Bart, 1995; Jan Hansen and Werner, 2000) findings, our findings support the fact that these are crucial factors in determining the equilibrium real exchange rate. The Real Effective Exchange rate is positively but insignificantly affected by terms of trade. The estimated results of the ARDL methodology are shown in Table 4.3.

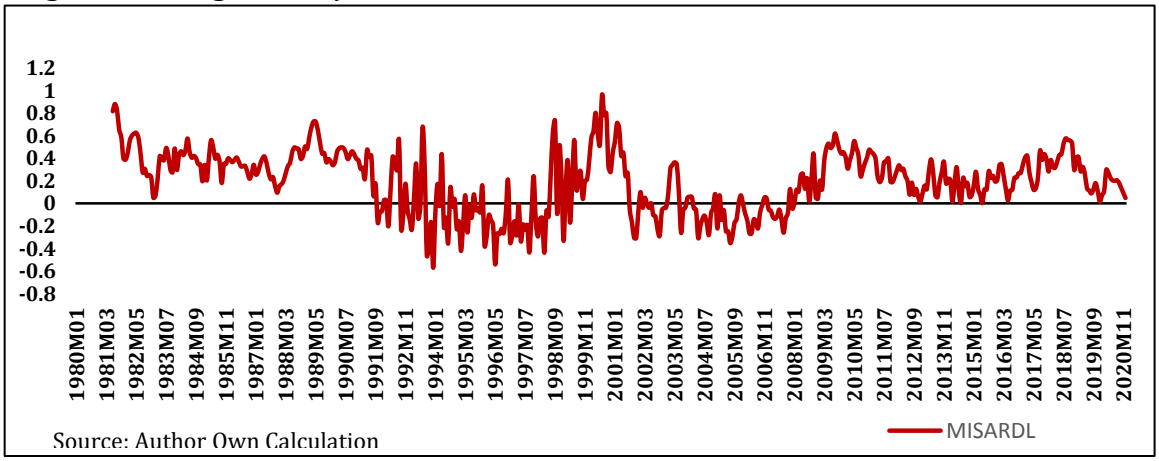
**Table - 4.3 Results of ARDL**

| Variables | Coefficient | P-value. |
|---|---|---|
| **C** | 0.022 | 0.685 |
| **REER (-1)** | -0.013 | 0.017 |
| **TOT** | 0.005 | 0.449 |
| **NFA** | 0.004 | 0.021 |
| **GOVINVES** | 0.006 | 0.025 |
| **GOVCON** | -0.012 | 0.000 |
| **IDIFF** | 0.010 | 0.003 |
| **D(REER (-1))** | 0.283 | 0.000 |
| **D(REER (-2))** | -0.133 | 0.003 |
| **ECM** | -0.923 | 0.000 |
| | **Level equation** | |
| **TOT** | 0.407 | 0.432 |
| **NFA** | 0.286 | 0.074 |
| **GOVINVES** | 0.474 | 0.020 |
| **GOVCON** | -0.861 | 0.006 |
| **IDIFF** | 0.083 | 0.041 |
| **C** | 1.611 | 0.642 |
| **R-squared** | | 0.996 |
| **Adjusted R-squared.** | | 0.996 |
| **S.E. of regression** | | 0.016 |
| **Durbin-Watson stat** | | 1.960 |
| **AIC** | | -5.401 |

Dependent Variable: REER

The misalignment found through ARDL shows different episodes of misalignments being both overvalued and undervalued in different periods (Fig – 4.3).

**Fig *4.3: Misalignment by ARDL***




Source: Author Own Calculation

t is found that Misalignment estimated in Behavioral Equilibrium Exchange Rate (BEER) Model showed different episodes of overvalued and undervalued exchange rates. It is mentioned that ARDL serves in distinguishing between the long- and short-term behavioral effects of explanatory variables on misalignment. One other important finding is that, over

the time horizon from the 1980s to 2020, most of the time, the exchange rate remained overvalued. Though in the 1980s, economic development and poverty reduction were observed, Pakistan's economic and social indicators fell in the 1990s. The data suggest that economic growth slowed, inflation increased, debt soared, macroeconomic imbalances worsened, and poverty nearly doubled. Pakistan's credibility in the international financial world was poor after failed deals with international financial institutions (IFIs). Local investors' confidence was shaken when resident and non-resident Pakistanis' hard-earned foreign currency deposits were blocked. After May 1998, foreign currency deposits were a major source of external liquidity. Freezing foreign currency deposits eroded confidence, which affected other foreign exchange inflows. Official worker remittances were $1 billion. Less than $400 million was invested abroad. Meanwhile, foreign exchange demand rose. Oil import prices doubled from $1.3 billion to $2.6 billion in the first year, from $14 to $15 per barrel to $28 to $30 per barrel. Due to the military government's establishment in October 1999, new sanctions were placed on Pakistan and official flows were suspended. All these factors became responsible for moving the exchange rate from overvalued to undervalued. Thus, divergence intensified after 1999 and persisted through 2001. In 2001, the exchange rate started returning to the equilibrium value. The first quarter of 2001 saw the most significant exchange rate and monetary policy events. On July 21, 2001, the State Bank of Pakistan approved a floating exchange rate, and on August 22, 2001, it defended the currency at Rs 55 per dollar. Without direct involvement or moral persuasion, the SBP permitted market forces to decide the currency rate under this strategy. However, on 19 September 2001, the SBP released the Rupee once more, resulting in a sharp devaluation of 4.8% (interbank sell rate) in a single day. It was argued that if SBP had not strengthened the monetary policy to stabilize the currency rate, the speculative attack would have caused the Rupee to tumble. Although monetary policy instruments and banks' decision to impose cash margins on imports alleviated strains on the foreign currency market, the consequent liquidity

tightness has led to a rise in T-bill rates and is beginning to exert upward pressure on lending rates.

Things continued to remain almost the same till 2008 when the exchange rate became again misaligned and overvalued. In 2008, inflationary pressures increased in the global economy. Throughout the duration of 2008, worldwide commodity prices accelerated, with several commodities hitting record highs. Thus, the worsening of the current account deficit, which began in FY2005, continued for a fourth consecutive year, reaching an all-time high of that time around 8.4% of GDP in FY2008. The substantial deterioration in Pakistan's external account was compounded by a drop in the financial account surplus over time. As a result, both the currency rate and the SBP's foreign exchange reserves were under pressure. The exchange rate depreciated and started moving toward its equilibrium.

After 2009, Pakistan's external account began to strengthen, providing the economy with much-needed breathing space. This improvement was due more to positive global market trends than the domestic business climate. Specifically, the increase in demand and prices for Pakistani exports and substantial growth in remittances were the primary contributors to the country's external position improvement. Moreover, supply activities grew for NATO soldiers throughout the Afghanistan War. Thus, Pakistan's foreign account situation remained stable. These increases in inflows led to the overvaluation of the exchange rate.

Nevertheless, in FY 2012, the exchange rate started depreciating. Thus, the Rupee depreciated by 9.1% on average in FY 2012. The main reasons were lumpy oil payments and IMF debt repayments. Further, the Pak Rupee depreciation remained reasonably moderate for the majority of the year. In contrast, the value of the Pakistan Rupee. The incident on the Pakistan–Afghanistan border on 26 November 2011, resulted in the deaths of twenty-four Pakistani servicemen. Pakistan barred both routes and continued to do so until July 2012.

Beginning in 2012, the government permitted the shipment of perishable foods across its airspace. In April 2012, the Pakistani parliament reversed its earlier decision and restored the NATO supply lines to rebuild bilateral relations between US and Pakistan. The exchange rate again became overvalued and misaligned till 2013. However, the misalignment began shrinking in 2014 and was minimal by 2016. By the end of 2017, it had risen dramatically again. This is the time when the economy was suffering not only from the energy crisis but also from domestic security conditions were worst. These factors hindered capital inflows, especially through exports and foreign investment. However, the signing of the CPEC (China Pakistan Economic Corridor) with China initially brought favorable macroeconomic conditions. Further, a new IMF program was initiated with the thrust of making Pakistan's economy stable in the long run. Initially, government policies aligned with the IMF benchmark put the economy on a higher growth path. It is mentionable that the higher growth momentum (5.5 %) observed in 2018, was unsustainable due to the high fiscal deficit along with the current account deficit. Though, twin deficits always persisted in the economy with some degree of variation. Some of the requisite adjustments on fiscal accounts like the rise in energy and administrative prices were delayed due to the election year in 2018.

Further, the maintained exchange rate resulted in severe macroeconomic imbalance through the depletion of foreign reserves and an increase in monetary borrowing. It is stated that a low inflation rate caused high consumption expenditure. Thus, a massive surge in imports was seen. To address growing imbalances, particularly in external accounts, the exchange rate was realigned with the market conditions. In 2018, the newly elected administration began negotiating the IMF program as the economy was under pressure from domestic and external macroeconomic imbalances and the foreign reserve was below the necessary adequacy level. The IMF Executive Board agreed on a 39-month extension of Pakistan's Extended Fund Facility (EFF) on July 3, 2019. Following the IMF program, the

exchange rate fell. A market-based exchange rate was another program requirement. So, the exchange rate mismatch began diminishing by 2020. Thus, the Pakistani rupee depreciated against the dollar to around Rs. 159.1 in Dec 2020.

To summarize, in the era of 1999-2003, 2008-2012, and 2015-2018, the governments used to keep the overvalued exchange rate in the context of false idealism. However, the slowdown in foreign inflows to Pakistan, caused by international financial market turbulence, political transition, and depleting foreign exchange reserves exerted pressure on the currency rate. Thus, overvalued misaligned exchange rate has to be eroded as a prerequisite for creating macroeconomic balances.

**4.4 Combining misalignment with fluctuation.**

For our analysis, misalignments were combined with fluctuations to make four cases. It is revealed that sometimes the exchange rate was overvalued but then fluctuation itself corrected the misalignment. Likewise, the exchange rate was undervalued while fluctuation corrected the misalignment. Moreover, sometimes fluctuations made the exchange rate more misaligned, making it diverge from the equilibrium. Thus, in this study, four cases were constructed by combining fluctuations and misalignments, out of which two are convergent and two are divergent.

Case-I: Overvaluation with appreciation

Case-II: Overvaluation with depreciation

Case-III: Undervaluation with appreciation

Case-IV: Undervaluation with depreciation

Case I implies that currency is already overvalued (above the equilibrium level) but further appreciation implies divergence from equilibrium. Conversely, Case II is the convergent case because the exchange rate is overvalued, and depreciation will lead to its equilibrium level. Likewise, Case III is the appreciation of the currency when the exchange rate is undervalued

implying below the equilibrium level, so the appreciation of currency will take it to the equilibrium level. Finally, Case-IV is also divergent in that currency is undervalued from equilibrium, but further depreciation will take it away from the equilibrium.

Figures 4.4 A and B depict the misalignment and fluctuation whereas misalignment in misalignment in 4.4 A is estimated by ARDL while 4.4 B is by simple regression framework.

**Fig *4.4 A: Misalignment by ARDL and Fluctuation cases***

**Fig*-4.4 B: Misalignment by Simple Regression Framework and Fluctuation cases***

The analysis is made from 1980 because Pakistan was following a fixed exchange rate regime till 1981. On January 8, 1982, Pakistan adopted a managed floating exchange rate system. Further, in the analysis, monthly frequency of exchange rate data is used, there are the different periods in which four cases constructed in the study by combining fluctuations and misalignments, occurred frequently. Out of these two are convergent and two are divergent. The time of these occurrences can be months or even a year or two and so on. Here we are explaining those which remain at least for one year.

**Case-I of this study i.e., Overvaluation with appreciation**

**Jan 1981 to May 1984**: It is mentionable that the exchange rate remained overvalued mainly on account of better economic performance and a high influx of capital inflows. Starting from the early 1980s, the long gestation period Indus Basin Terbela Dam helped unleash

extraordinary agricultural growth, while investments in fertilizer and cement led to industrial expansion. In addition, increased worker remittances significantly boosted economic activity. In addition, the administration was allowed, for the first time in Pakistan's history, to engage with the United States for greater external aid. In addition to giving direct aid to Pakistan, the United States and its allies contributed an additional $5 billion to $7 billion to the local economy. Similarly, the narcotic trade gathered momentum till 1984 strongly bolstering the service sector of the economy. Hence, the exchange rate which was overvalued further appreciated due to favorable economic circumstances.

**Oct 2013 to Feb 2016**: During this period, the economy of Pakistan moved toward a higher growth trajectory. A conducive policy environment was one of the primary contributors to this momentum. Increased government spending on infrastructure and historically low-interest rates boosted domestic demand, while an improvement in the energy supply situation removed a critical bottleneck impeding industrial performance. These policy actions were complemented by improvements in the security situation. Even though the current account deficit expanded, it was comfortably covered by financial inflows. In reality, net FX inflows during this period were greater than outflows, resulting in the buildup of the highest foreign exchange reserves. The successful conclusion of the IMF program in 2016, not only provided direct FX support but also enabled the country to get finance from other IFIs and the international capital market. This, in turn, led to FX market stability. Thus, the exchange rate appreciated in this period, though it was overvalued.

**Case - II of this study i.e., Overvaluation with depreciation.**

**Jun 1984 to July 1987**: The fiscal crisis that gripped the economy in the late 1980s is largely attributable to the increase in military spending. Furthermore, international help began to decline. In addition, several state-owned enterprises, such as steel mills, have achieved

capacity. Thus, from the beginning of FY 1983, the currency started depreciating as inflation in Pakistan was higher than that of its principal trading partners.

**Jan 2000 to Aug 2001:** This era is a mixture of economic performance. The fiscal consolidation took place to restrict fiscal deficit which will in turn make the Pakistani rupee stable. Thus, the tax survey and documentation drive by the year 2000 enabled the FBR to bring in extra income taxpayers and new sales taxpayers. On the external side, however, the export front posed the greatest difficulty. In 1999-2000, Pakistan's exports decreased to $6.4 billion. Imports, which increased to almost $12 billion in 1996-97, will fall to $8 billion in 2000. Thus, the overvalued exchange rate has to depreciate for addressing risks associated with the external sector.

**Feb 2005 to Mar 2008:** During this period, the government continued with the policy package associated with the "Washington Consensus" which was privatization, fiscal discipline, and trade openness. Thus, the government implemented policy reforms like privatization, investment deregulation, trade liberalization, financial liberalization, and tax reforms. However, the governments during this period found it difficult to maintain fiscal discipline, they were forced to implement stabilization programs. Thus, the overvalued exchange rate was not able to continue. Thus, depreciated for ensuring macroeconomic stability.

**Apr 2011 to June 2013:** Despite a large increase in tax revenue, public finances deteriorated very significantly. Further, security concerns, energy crises, and structural weaknesses hamper economic growth. Though, the Coalition Support Fund (CSF) from the US had given some support to the external sector. but domestically, the economic cost of the Afghan war on Pakistan remained much higher. This war further weakened law & order in the country, which badly impacted the investment climate, caused output losses owing to frequent economic activity pauses, diverted resources to increase security, and pushed manpower and

some enterprises to leave the country. This hampered government revenue collection. Insufficient foreign funding forced domestic sources, notably the banking system, to finance the budget deficit. The lack of external inflows made financing the small current account deficit difficult. Hence the overvalued exchange rate depreciated on account of the economic factors discussed above.

**Apr 2018 to Dec 2020:** During this time, the economy experienced twin deficits. Due to the election year, some necessary adjustments to fiscal accounts, such as the increase in energy and administrative costs, were delayed. The continued maintenance of the exchange rate resulted in a serious macroeconomic imbalance due to the depletion of foreign reserves and the expansion of monetary borrowing. It is stated that a low inflation rate led to a rise in consumer spending. Thus, there was a tremendous increase in imports. To immediately address rising imbalances, especially in external accounts, the exchange rate was readjusted to reflect market conditions. Thus, the Pakistani rupee declined against the dollar from Rs. 121.48 in 2018 to approximately Rs. 159.1 in Dec 2020.

**Case-IV of the study: Undervaluation with depreciation**

**June 1988 to Mar 1993:** The year 1988 is characterized by political instability, sluggish economic growth, and recurrent foreign exchange problems. Pakistan has to seek bailout packages from the IMF. In Oct 1990, Pakistan had to face the imposition of Pressler sanctions. These sanctions led to a major reduction in foreign funding. Further, in the early 1990s, despite the expansion of trade, Pakistan's inflation remained much higher than that of its principal trading partners. Thus, the rupee needed to fall to offset the impact of domestic inflation on the real exchange rate. Thus, in the period between June 1988 to Mar 1993, the currency remained undervalued as well as suffered depreciation in most of the months. During the period 1988 – 1993, the currency depreciated by 32 percent as the exchange rate 1$ = 17.599 in FY 1988 became 1$=25.959 in FY 1993.

**Sept 2001 to June 2003:** 2002 has been the most difficult fiscal year for the global economy and Pakistan's economy in particular. This year has seen a global experience of dramatic transformations. Numerous epoch-making events transpired on the worldwide and national stage, which had an effect on the economies of nations all over the world, including Pakistan. Specifically, the events of September 11 and December 13, as well as their aftermaths, and the continuation of disastrous drought conditions slowed economic recovery. Thus, the exchange rate which was undervalued further depreciated.

**Case -III of this study: Undervaluation with appreciation**

**Nov 1993 to May 1996:** Though in the period between 1993 to 1996, significant exchange rate fluctuations between depreciation and appreciation were observed. But the exchange rate remained undervalued during the said period. By that time, SBP also started following the policy that balances exchange rate stability to enhance competitiveness. Thus, SBP analyzed competitor currencies to manage the rupee's value. Further, GDP performance throughout this time remained satisfactory. Thus, the package of stabilization measures announced by the government resulted in creating macroeconomic balances. So, the exchange rate started appreciating, though it remained undervalued during the period under discussion.

**Aug 2003 to Jan 2005:** During this period, Pakistan was able to restore its economic sovereignty from the IMF as early as 2004 as a measure of the success of the implemented policies. The economy was able to stand on its own and had the resilience to endure foreign and internal shocks. Pakistan reestablished investor confidence. Workers living overseas sent their wages through official means. Because the country's legitimacy had been established, international financial institutions were eager to offer help. The international financial markets responded enthusiastically to Pakistan's bond and stock offerings. Thus, the exchange rate which was undervalued moved toward its equilibrium value through appreciation.

**Aug 2009 to Oct 2010:** During this period, Pakistan's economy saw a moderate rebound. Real GDP increased due to improvements in business and consumer confidence. Further, with accommodative monetary and fiscal policies, and some good fortune (in the form of falling overseas prices), a significant fall in the current account deficit occurred which in turn made the external account balance achieve a surplus in FY10 after a two-year deficit. Thus, the undervalued exchange rate started appreciating on account of better performance of the external sector.

### 4.5 Construction of Cases by extending the NARDL model

We followed the NARDL methodology to represent these cases, as Shin et al., (2014) proposed a paradigm based on the nonlinear autoregressive distributed lags (NARDL) model. It is the technique that is used to simulate nonlinear cointegration and dynamic multipliers. The approach introduces short and long-run nonlinearities into the explanatory variables via positive and negative partial sum decompositions. It is demonstrated that their model is estimable using the least square methodology and that reliable long-run inference can be performed via bounds testing, regardless of the variables' order of integration.

To combine fluctuations and misalignments we followed Shin et al., (2014) methodology as used in NARDL. However, the NARDL method provides a series of cumulative dynamic multipliers used to trace out the adjustment patterns following the positive and negative shocks to explanatory variables. To follow the NARDL methodology and modified the Shin methodology, four cases were constructed by combining misalignment and fluctuation. Thus, four cases by combining misalignment and exchange rate fluctuations are as follows: Case-I implies that the currency was already overvalued (above the equilibrium level) but further appreciated, implying divergence from equilibrium; Case-II is the convergent case because the exchange rate was overvalued and depreciation will lead to its equilibrium level; Case-III is currency appreciation when the exchange rate was

undervalued implying below the equilibrium level, so currency appreciation will take it to the equilibrium level. Finally, Case-IV is divergent in that the currency was undervalued relative to equilibrium, but further depreciation will take it out of equilibrium.

The equations are as follows:

$$POS\_OVERt = \sum_{j=1}^{t} \Delta REER_j{}^{+} + \sum_{j=1}^{t} MISREER_j{}^{+}$$
$$= \sum_{j=1}^{t} max(\Delta REER_j, 0) + \sum_{j=1}^{t} max(MISREER_j, 0)$$
$$NEG\_OVERt = \sum_{j=1}^{t} \Delta REER_j{}^{-} + \sum_{j=1}^{t} MISREER_j{}^{+}$$
$$= \sum_{j=1}^{t} min(\Delta REER_j, 0) + \sum_{j=1}^{t} max(MISREER_j, 0)$$
$$POS\_UNDERt = \sum_{j=1}^{t} \Delta REER_j{}^{+} + \sum_{j=1}^{t} MISRER_j{}^{-}$$
$$= \sum_{j=1}^{t} max(\Delta REER_j, 0) . + \sum_{j=1}^{t} min(MISRER, 0)$$
$$NEG\_UNDERt = \sum_{j=1}^{t} \Delta REER_j{}^{-} + \sum_{j=1}^{t} MISREER_j{}^{-}$$
$$= \sum_{j=1}^{t} min(\Delta REER_j, 0) + \sum_{j=1}^{t} min(MISREER_j, 0)$$

Each of these series includes partial sums that solely contained increases or decreases in the series. According to Granger et al., (2002), hidden cointegration occurs when the positive and negative components of two-time series are cointegrated, and linear cointegration is a special example of this hidden cointegration, which is a simple case of nonlinear cointegration.

**4.6 Measurement of exchange rate uncertainty**

Exchange rate uncertainty creates an atmosphere in which businesses are unable to make comfortable decisions regarding imports and exports. This would negatively impact international trade, foreign direct investment, trade earnings, trade volumes, as well as economic growth and welfare. Thus, the uncertainty of exchange rates poses a risk. A greater

risk will result in a higher cost for risk-averse investors, which will, as a result, lower economic activity. Therefore, the transaction costs will be higher the more uncertain the situation is. Further, the uncertainty in the exchange rate on domestic investment is also unsatisfying.

There is consensus in the literature that exchange rate uncertainty negatively impacts international commerce, FDI, trade earnings, trade volumes, economic growth, and overall well-being (Hooper, 1978 and Banik, 2020;). Regarding exchange rate uncertainty, the uncertainty leads to the unpredictability of business revenues and costs. Further, if revenues and costs are in different currencies, possible exchange rate variabilities are a crucial facet of the uncertainty. For example, in the course of the decision to revive the IMF program, the exchange rate may depreciate significantly. Still, this will not motivate investment decisions; instead, investors will hold the investments until the finalization of the negotiations. Thus, measuring exchange rate uncertainty is essential for analyzing the impact of variations in the exchange rate on economic activity and price level as per the objective of the study. In this study, for uncertainty in the exchange rate, its volatility has been estimated by using a univariate Generalized Autoregressive Conditional Heteroskedasticity model utilizing monthly data on the real effective exchange rate. Engle, (1982) and Bollerslev, (1986) describe the GACRH model as follows:

$$REER = c + \alpha REER_{t-1} + \varepsilon_t + \phi\varepsilon_{t-1}$$

$$\sigma_t^2 = \beta_0 + \beta_1\varepsilon_{t-1}^2 + \vartheta\sigma_{t-1}^2$$

where REER stands for the real effective exchange rate. This model was chosen from the ARCH family, like Benavides and Capistran, (2012). Hansen and Lunde, (2005) found no evidence that the GARCH model could be surpassed by more advanced models when they analyzed ARCH-type models. Bartsch, (2019) identifies the GARCH model as a “simple and difficult to beat” model that is often used to model exchange rate volatility.

**Table 4.4. Heteroskedasticity Test: ARCH**

| | | | |
|---|---|---|---|
| F-statistic | 4.539 | Prob. F (1,488) | 0.033 |
| Obs*R-squared | 4.516 | Prob. Chi-Square (1) | 0.033 |

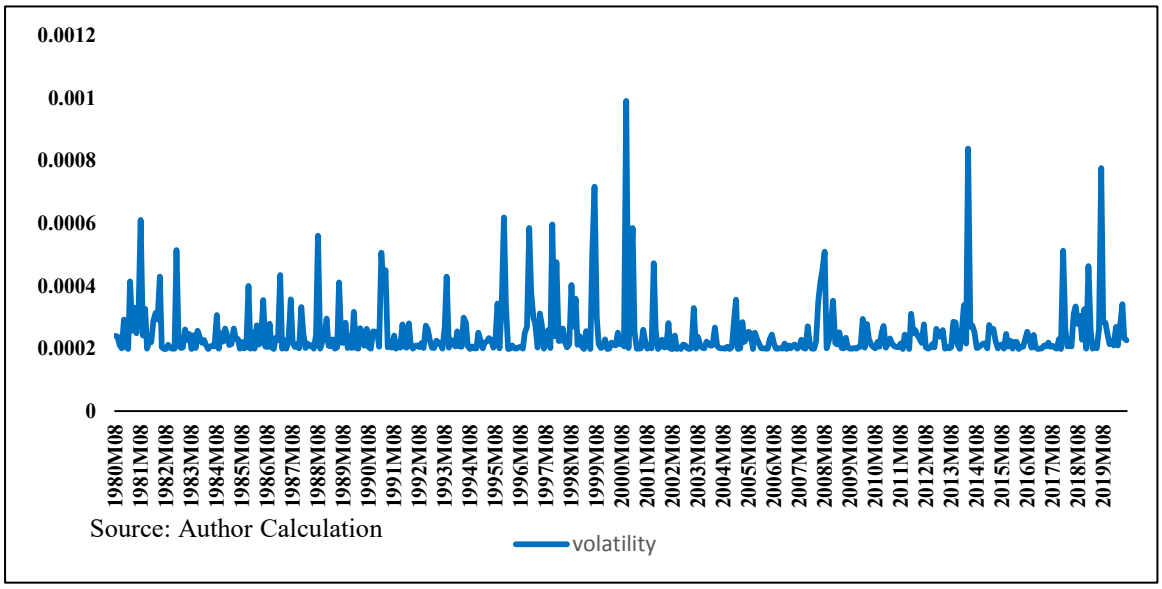
For testing the ARCH effect, the results of ARCH LM are presented in table 4.4. The results indicate the rejection of null hypothesis of no ARCH effect as the probability value is 0.03. Furthermore, according to Sauer and Bohara, (2001), adhoc non-parametric measurements of exchange rate volatility excludes "essential information" about the stochastic process that prevails in exchange rates. The conditional variance of the exchange rate is obtained using the GARCH methodology (Caporate and Doroodian, 1994). The GARCH model allows the conditional variance depending on its own lag as well as the squared error terms of the ARCH model. It is included in the specification to adjust for the series' persistence. Its presence suggests that we are attempting to estimate a dynamic model. The empirical approach is carried out in two stages. To construct our exchange rate volatility measure, firstly estimate the ARCH model then apply the LR ratio test and correlogram square test.

**Table 4.5 Exchange rate volatility model**

| Mean Equation | | | | |
|---|---|---|---|---|
| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
| C | -0.001 | 0.001 | -1.279 | 0.201 |
| MA (1) | 0.365 | 0.051 | 7.213 | 0.000 |
| Variance Equation | | | | |
| C | 0.000 | 0.000 | 15.656 | 0.000 |
| RESID (-1)^2 | 0.171 | 0.062 | 2.788 | 0.005 |

For measuring volatility, the result of the arch model is presented in table 4.5. The variance series is estimated by using this equation for future analysis. The result was estimated by the GARCH model and then the variance of the series was calculated. Figure 4.8 shows exchange rate volatility which can be considered a measure of uncertainty.

*Fig – 4.5 Exchange Rate Uncertainty (Volatility)*




Source: Author Calculation

The uncertainty of the exchange rate affects the market decision of investment which eventually affects the economic activity and price level of the economy. The analysis of exchange rate volatility depicts that it remained for the whole period from 1980 to 2020, but its intensity fluctuated in different years depending on the ongoing circumstances. The high volatility was observed between 1995 to 2000, while in 2008, 2013, and 2018, the intensity of volatility increased. One of the reasons found was that during an election year, the outgoing government usually tries not to change the level of existing exchange rates. The agents, unaware of the new government's stance, hold their decisions primarily related to investment. Thus, volatility in these periods remained greater. Further, political instability, as seen during 1995 – 1999, also resulted in high volatility. The impact of this is that the fluctuations of the exchange rate can be traced to the uncertainty associated with exchange rate markets which thus impact the decisions of producers, especially those involved in exports and imports of goods.

Uncertainty influences every aspect of business and consumer decision-making, putting economic agents under pressure. Because disruptions in business investment, household spending, and foreign trade this has global ramifications. Uncertainty in policy can affect exchange rates by altering relative economic fundamentals. Policy uncertainty has been

shown to impact foreign exchange returns significantly and can be used to forecast exchange rate volatility (Abid,2019). Although exchange rate uncertainty can be used to anticipate exchange rate returns and volatility, it does not consider the impact on analyst forecasts. The more volatility in the exchange rate, the more uncertainty is, whereas uncertainty can impact macroeconomic variables with its dynamics.

### 4.7 Conclusion

In this chapter, we have given a full picture of the variation in the exchange rates. It is mentioned that variation can be considered of three types; one is misalignment, the other is fluctuation, and the third is volatility. Though volatility of the exchange rate represents uncertainty in the exchange rate.

Although there are different methods to estimate the equilibrium exchange rate, in this study, two approaches have been used. One is by using PPP and the second is the BEER method. The BEER is estimated by a simple regression framework and dynamic regression framework, the ARDL model. The result of the estimation showed that from 1980 until 2020, the exchange rate misaligned most of the time and it remained mostly overvalued. In the early 1980s, the exchange rate remained overvalued because of the perception that a strong currency reflected a healthy economy. Although the fixed exchange rate system was removed. However, the managed and dirty played a vital role in deciding the value of the currency. From 1991 through 1999, the exchange rate fluctuated between undervalued and overvalued phases. Usually, overvalued exchange rates created higher trade deficits through high imports. Resultantly, the current account deficit widened. Since Financial Accounts were unable to offset a wide Current Account Deficit, hence Foreign Reserves were depleted. In managed exchange rate, SBP devalued the currency resulting in undervaluation. The late 1990s-early 2000s saw the exchange rate undervalued. In 2008, there was a democratic transition, but the government tried to keep the currency overvalued opposite to what had

been observed previously or in the time of the Musharaff era. It was done to restore the general public's confidence. In public perception, movement in the nominal exchange rate is linked with the strength of the government. However, in any IMF program discussion, the first doable advice is the correction of the misaligned exchange rate.

For proceeding to further investigation, misalignments calculated with any of the methods discussed above was divided into overvaluation and undervaluation. Then it was combined with the exchange rate fluctuations (appreciation and depreciation) to develop four cases. Effects of exchange rate on economic activity and prices are then estimated with regards to these four cases of misalignment and fluctuation, which are the subject matter of the next two chapters.

# Chapter 5

## Effect of Combination of Fluctuations and Misalignments along with Uncertainty of Exchange Rate on Economic Activity: A linear and Nonlinear Analysis

### 5.1 Introduction

For ages, governments and monetary authorities have been engaged in designing economic policies to promote economic activity. Usually, economic activity is related to growth in real GDP. Nevertheless, for a consistent increase in economic activity, every macroeconomic policy revolves around macroeconomic stability because it is a prerequisite for equitable and sustainable economic growth. After World War II, the definition of macroeconomic stability turned into a combination of external and internal balance. Therefore, macroeconomic stability requires that the structure of a country's economy leads to long-term growth along with a reduction in its internal and external vulnerabilities.

Two primary factors, the level of real domestic demand and the real exchange rate, which in turn reflect underlying economic conditions and macroeconomic policy, determine the state of the external and internal balances. For example, a current account deficit might emerge if the real exchange rate is overvalued, real domestic demand is excessive, or both conditions are present. In the opposite circumstance, there will be a current account surplus. Similarly, a depreciated real exchange rate or an excess of real domestic demand generates inflationary pressure, but the opposite situation results in a decline in output. A nation with a balance of payments problem generally must design macroeconomic policies with the prime objective of adjusting either the growth or inflation rate. Therefore, in recent literature, the exchange rate variation has also become a variable of interest.

It is important to note that unexpected and significant exchange rate fluctuations sometimes dampen the buffer created through macroeconomic activity. The exchange rate affects the economy in several ways, but there is no consensus on the linkages and directions

of the impact. The exchange rate influences macroeconomic variables via the demand channel. The variations in the exchange rate affect consumption and production as well. Moreover, continuous fluctuations in the exchange rate make people and organizations worried about investment leading to the withdrawal of investment. This will result in depressing total economic activity. Aggregate demand is also affected by exchange rate changes via imports and exports. Further, exchange rate fluctuations can also lead to high inflation and affect the economy's debt level, thus restricting economic growth through compression in demand.

Historically, it has been observed that the economic growth rate in Pakistan remained quite volatile. The high growth episodes have been accompanied by three significant disturbing factors: large fiscal and current account deficits, low savings and investment rates, and low human capital formation. It is mentionable that for treating internal and external imbalances of the economy, appropriate domestic macroeconomic policies are required.

It has also been observed that misalignment of the exchange rate and fluctuations in the exchange rate affect economic activity differently. In the context of exchange rate misalignment, some governments try to maintain it on a level away from the equilibrium (undervalued or overvalued) for some political purposes. These disequilibria, even in the short run, create macroeconomic imbalances. For example, an overvalued exchange rate adversely affects competitiveness, thus deteriorating the trade balance. Likewise, an undervalued exchange rate may translate into high production costs due to increased import bills, thus affecting economic activity. This condition is evident in countries like Pakistan where raw materials or capital goods have the highest share of imports. Fluctuation of the exchange rate, which is appreciation and depreciation, affects economic activity through purchasing power and the competitiveness level of the economy.

As discussed earlier, in the literature, a combination of fluctuations and misalignment has not been used simultaneously for analyzing the impact of exchange rates on macroeconomic variables. In literature (Hooper, 1978 and Banik, 2020), it has been found that when the economy faces an overvalued exchange rate, then imports become cheaper in the local currency, and its demand increases, especially in import-dependent developing countries where industries depend on imported capital goods. Even if investors hold domestic investments, exchange rate fluctuations can significantly influence investment portfolios. For instance, a strong dollar typically reduces worldwide demand for commodities priced in dollars. This decreased demand can impact earnings and valuations for domestic commodity producers, although the weaker local currency will buffer some of the adverse effects.

Importing at an overvalued exchange rate is cheaper than local manufacturing, especially in an import-dependent nation. Regarding undervaluation, it has been observed that undervaluation is more appealing to foreign investors. Thus, foreign direct investment increases, which has a spill-over impact on economic activity. There are both direct and indirect impacts of exchange rate fluctuations. However, like an iceberg, most of the indirect impact of exchange rate fluctuations occurs below the surface. Exchange rates indirectly impact the prices, the interest rates, the returns on investments, job prospects, and possibly even housing prices.

In this study, it is hypothesized that the impact of fluctuations in the exchange rate on the economy when moving toward equilibrium will be different from that when the exchange rate is moving away from equilibrium. Thus, there is a need to use fluctuations and misalignment in exchange rates simultaneously for analyzing the impact of exchange rates on the economy. Thus, the second objective is to examine the effects on economic activity by combining exchange rate misalignment and fluctuations along with the uncertainty of the exchange rate. Therefore, economic activity has been used as response variables for the

analysis, while interest rate, inflation rate, oil prices, trade openness, volatility, and real effective exchange rate, misalignment of exchange rate have been used as control variables. Further, an indicator variable for using misalignment and fluctuations of exchange rate simultaneously has been taken as the primary variable of interest. Thus, four cases have been made by combining misalignment and fluctuations of the exchange rate: Case-I implies that currency was already overvalued (above equilibrium level) but further appreciated, which implies divergence from equilibrium; Case-II is the convergent case because the exchange rate was overvalued and depreciation will lead to its equilibrium level; Case-III is the appreciation of the currency when the exchange rate was undervalued implying below the equilibrium level, so the appreciation of currency will take it to the equilibrium level; finally, Case-IV is also divergent in which currency was undervalued from equilibrium, but further depreciation will take it away from the equilibrium.

Linear and nonlinear models have been estimated to analyze the impact. Linear relationships are modeled by the ARDL model, while nonlinear relationships are estimated using the NARDL model. Two types of NARDL models have been analyzed; one is conventional NARDL and the second is NARDL with four cases by combining misalignment and fluctuations of the exchange rate as discussed above. The rest of this chapter includes the conceptual framework, econometric methodology, results, and discussion, while the conclusion and policy recommendations are discussed in the last.

### 5.2 Conceptual Framework

The variations in the exchange rate have critical linkages with the macroeconomic framework. Economic activity is affected by the performance of real, fiscal, monetary, and external sectors. These four economic sectors are interlinked with each other. For example, the fiscal deficit drives future borrowing volumes. However, the fiscal deficit, in turn, depends on the real sector performance. Further, the monetary and exchange rate policies

influence the types and costs of available sources of financing. Additionally, the balance of payment gaps may require external financing. All these sectors and corresponding linkages are affected by disturbances in the exchange rate. It is important to note that the impact of any given macroeconomic variable can be determined by studying the interconnections among the various accounts (which include both accounting and behavioral linkages).

It is mentioned that "real business cycle" theorists believe that the transmission is unaffected by exchange rate regimes or monetary forces. However, exchange rate disturbances have monetary and real effects as well. Thus, there must be some nominal rigidity or imperfection for these disturbances to have real effects. Furthermore, these disturbances are transmitted through several channels, the most notable of which is the current account of the balance of payments, which has consequences for relative prices, output, and income. Interest rate differentials that eliminate interest rate inequality (other than for disparities in risk premia, taxes, or transaction costs) can likewise spur capital outflows. Finally, the exchange rate regimes currently in place make foreign exchange arrangements critical.

There are different channels to analyze the exchange rate's effects on economic activity, the demand channel, supply channel, and balance of payment channel. The ***demand channels*** can be divided into four subchannels, consumption, investment, government spending, and trade balance.

**Consumption** can be hampered through direct and indirect channels from the exchange rate variations as found by Obstfeld and Rogoff, (1998). Regarding the direct channel, firms and households generally react adversely to variations, influencing their consumption decisions. Furthermore, production, income, and trade are all hampered by extraordinary fluctuations in the exchange rate, which in turn impacts consumption. When it comes to the indirect channel,

businesses may increase their prices as a means of protecting themselves from the potential negative effects of fluctuations in the exchange rate on their businesses.

**Investment** is also affected by changes in the exchange rate by two channels. The first channel is to affect the marginal profit of an investment, affecting the firms' revenues. Secondly, the price of imported capital influences corporate costs (raw material). With greater financial integration, many countries are more receptive to foreign investors. Thus, economies are growing flexibly to attract foreign capital flows, and investors want to diversify globally. This makes foreign investment vital. As the exchange rate is a major determinant of foreign investment, exchange rate risk may be the most crucial. Phillips et al. (2008) found that exchange rate risk and FDI are linked by production flexibility and risk aversion.

An increase in **government expenditure** causes the native currency to appreciate, worsening the current account (and possibly causing a "twin deficit") and reducing consumption through international risk-sharing. This mechanism works in New Keynesian and neoclassical models.

Unexpected variations affect aggregate demand via exports, imports, and domestic currency demand, as well as aggregate supply via import costs. If the exchange rate depreciates, the supply channel will constrain output growth (Kandil, 2003). Standard Trade Theory simply links products with real exchange rate swings. A fluctuating exchange rate impacts both the value and volume of commerce. If the real currency rate in the home nation depreciates, households can receive fewer imported commodities for a unit of domestic goods and services. Imported goods give more domestic goods per unit. Foreign households buy more domestic goods while domestic households buy fewer imports. Depending on the country's economy, exchange rate swings might hurt economic activity.

The exchange rate influences **export and import** demand directly. A real depreciation of the home currency boosts exports and reduces imports, improving domestic product demand. Imported items that cannot be substituted for domestically produced goods, particularly intermediate and capital goods, counteract this benefit. These economic effects take years to spread. While the direction of the influence of exchange rate fluctuations on the economy is clear – a depreciation is frequently linked with an increase in activity and prices – its magnitude and the industries it affects are less predictable.

The channels discussed above are considered demand channels through which the exchange rate affects economic activity. Exchange rates also affect economic activity through another channel which is ***aggregate supply***. Expected changes in the exchange rate will affect imports. Imports are mostly related to raw materials. The effect of raw material prices affects supply through changes in production costs. Additionally, most economists believe that the investment had a substantial long-term impact but minimal short-term impact due to frequent changes in the exchange rate which ultimately affect the supply of goods and services.

The ***balance sheet*** channel is the third channel through which exchange rates affect economic growth. It is considered that the appreciation of the local currency strengthens the balance sheets of domestic borrowers denominated in foreign currency. Hence, easing domestic financial conditions may counterbalance the trade channel, boosting domestic economic activity. In contrast, a devaluation might undermine the economy by weakening domestic financial conditions. Thus, whenever there is a change in the exchange rate, there is a change in the debt amount; hence, the balance sheet is changed accordingly. Thus, affecting economic activity in the end.

The Mundell-Fleming model is commonly used to examine the impact of the exchange rate on economic activity in an open economy and free capital mobility. Regarding the exchange rate, there are several channels through which the effect transmits into

economic activity. The misalignment and fluctuation of the exchange rate both effects simultaneously. In literature, effect exchange rate of misalignment or fluctuations on economic activity has been estimated by many researchers, but both misalignment and fluctuations of exchange rates are used separately.

Nevertheless, misalignment and exchange rates affect economic activity differently. Politically motivated governments undervalue or overvalue the exchange. Thus, the real exchange rate requisite for macroeconomic balance can fluctuate over time due to the influence of economic fundamentals (also known as real exchange rate fundamentals). These include terms of trade, government expenditure, and revenue composition, real interest rates, and capital inflow and outflow.

As misalignment of the exchange rate often causes macroeconomic imbalances. Inflation decreases trade balance and competitiveness. An undervalued exchange rate can boost manufacturing costs, harming economic activity. This is clear in countries that import extensive raw materials or capital goods. Purchasing power and competitiveness are affected by exchange rate variations.

In some cases, the literature has established that exchange rate misalignment has asymmetric impacts. Specifically, overvaluation is detrimental to growth, whereas undervaluation is beneficial. However, misalignment has a distinct effect in developed and developing countries, with poorer countries being more vulnerable to the growth effects of misalignment (Dubas, 2009).

This research hypothesizes that all fluctuations do not hurt the economy, especially in its movement concerning equilibrium. It is important to note that the consequences of a change in the exchange rate on the economy will vary depending on whether the adjustment causes greater misalignment or lessens it. Thus, in this study, fluctuations and misalignment

have been used simultaneously along with uncertainty in the exchange rate and other control variables to analyze the effects of the exchange rate on economic activity.

Nevertheless, in analyzing the impact of the exchange rate on economic activity, the mechanism to affect the exchange rate through different channels is to comply with incorporating the explanatory variables in the model to analyze the effect. Inflation, interest rate, oil prices, the uncertainty of exchange rate, and trade openness in the model to analyze the impact of variation in the exchange rate on economic activity. Further, misalignment and fluctuations in the exchange rate as well as the combination of both were used in the model.

Pakistan is a developing economy, and capital goods have a significant share in the country's imports. It has been observed that when the exchange rate remains overvalued, it results in higher imports of both consumption and capital goods which sometimes also increases economic activity. Likewise, an increase in the worldwide price of oil, for instance, will affect the cost of production in an oil-importing country like Pakistan. In turn, this will lower the productivity of the traded goods, thus reducing exports. However, import costs will rise due to the depreciation of the exchange rate. Consequently, expanding the current account deficit may increase the browning of the economy. Increased demand for foreign currency would affect the exchange rate value, which is necessary to restore external and internal equilibrium.

The inflow and outflow of foreign currency would affect the domestic interest rate of the economy. Further, the interest rate is the tool used by the central bank to anchor inflation. Usually, the State Bank of Pakistan (SBP) raises interest rates to constrain aggregate demand by restricting investment and economic activity. In doing so, SBP believes that inflation is due to aggressive aggregate demand. In literature, it is found that pegged exchange rates have been shown to encourage investment because these reduce policy uncertainty and real interest

rates. Nonetheless, fluctuations in exchange rates may amplify stress, alter economic activity and price signals, and disrupt the sectors' capacity to allocate resources efficiently.

The relationship between the exchange rate and economic activity is still ambiguous and depends on other macroeconomic fundamentals. Thus, in the present research, the inclusion of interest rates is because of how the combination of misalignment and fluctuation in exchange rates affects economic activity. Exchange rates can affect inflation directly. For net importers, a depreciated currency can "import" inflation. Inflation decreases purchasing power per unit of money, depreciating the domestic currency. In an open economy, exchange rate variations affect the relative prices of domestic and imported goods, boosting domestic demand. Net exports affect demand and economic activity.

Though trade openness permits economies to grow output, improving returns to scale and specialization (Capolupo and Celi, 2008). An expansion of the trading sector, investments in the economy related to trading, and an increase in imports via trade routes may all contribute to short-term economic growth if a country is more "neutral" or "open" to international trade. Increases in disposable income and total demand. However, trade performance is also sensitive to exchange rate fluctuations and misalignments, as discussed earlier. Thus, in literature, trade openness is also considered an important variable when analyzing the impact of exchange rates on economic activity—economic activity is affected by a rise in marginal costs and relative international prices. Increased trade integration and the availability of more variations in the domestic market increase firms' steady-state price elasticity of demand and reduce their targets.

### 5.3 Econometric Methodology

The core objective of the study is to analyze the exchange rate's effect on economic activity. The exchange rate influences economic activity through different channels. Effects are not instantaneous but rather dynamics therefore, the variables have both short-run and

long-run relationship. In this case the traditional models that assume stationarity of series can't not be applied and the Autoregressive distributed lag models are commonly used to capture these dynamics.

The analysis using ARDL starts with the testing of basic stationarity assumption of time series analysis, because the variables used in ARDL models are assumed to be stationary or have been made stationary. Along with the assumption of stationarity it is also assumed that the variables are also cointegrated. The other assumptions about the variables used in ARDL models are the independence and identical of error distribution.

To avoid spurious relationships, we start an analysis by testing time series properties i.e. unit root test. If all the variables are integrated of the same order and their linear combination is integrated with order zero, then these variables are co-integrated. But usually, the level of integration of variables is not the same. These variables are integrated of different orders, I (0), I (1), or a mix of both. Therefore, the ARDL model is preferred when dealing with different levels of integration. There are some other advantages to using the ARDL models. ARDL models provide a flexible framework for modelling and analyzing the relationships between variables over time. Their ability to capture long-term relationships, handle endogeneity, and provide forecasting capabilities make them valuable tools in empirical research and policy analysis, particularly when dealing with small sample sizes.

Linear ARDL can assist in capturing the uniform impact of independent variables on the dependent variable. While NARDL analysis will aid in capturing the nonlinear impact of independent variables on the dependent variable, as suggested by Shin et al., (2014) in the literature. The variables of analysis were a mixture of stationary and nonstationary (results are presented in Appendix D). Therefore, we apply the ARDL methodology for analysis. In addition, both linear and nonlinear ARDL models were used for estimation.

It is also mentionable that the linearity test was used to confirm the nonlinearity. In this regard, the CUSUM statistic test and McLeod and Li (1983) test are used, which provide the basis of a formal hypothesis test for linearity. Contrary to the alternative hypothesis, which claims that the relationship is not linear, the null hypothesis asserts that it is linear. Further, the Akaike information criterion (AIC) and Schwarz Information Criterion (SIC) are used for model selection. Usually, the smaller the AIC and SIC value, the better the model fit.

**Bound test**

Pesaran et al. (2001) have developed a Bounds test to test whether the ARDL model contains a long-run relationship between dependent and explanatory variables. The details of the Bounds test are explained in the Chapter.

**Linear models**

**MODEL 1**

The objective is to analyze the effect of the exchange rate on economic activity. Thus, Model-1 is estimated by using economic activity as the response variable and real effective exchange rate as one of the explanatory variables, along with other explanatory variables including interest rate, openness, oil prices and inflation, and the uncertainty of exchange rate. The data and variable section discuss the reason and definitions of all variables. To capture the exchange rate short-run and long-run impact, the linear ARDL model is as follows.

$$\Delta \ln LSM_t = \eta_0 + \sum_{j=1}^{p} \eta_{1i} \Delta \ln LSM_{(t-j)} + \sum_{i=0}^{q} \eta_{2i} \Delta INFL_{(t-i)} + \sum_{i=0}^{q} \eta_{3i} \Delta (VOLI)_{(t-i)} + \sum_{i=0}^{q} \eta_{4i} \Delta (CMR)_{(t-i)} + \sum_{i=0}^{q} \eta_{5i} \Delta (REER)_{(t-i)}$$

$$+ \sum_{i=0}^{q} \eta_{6i} \Delta (LOIP)_{(t-i)} + \sum_{i=0}^{q} \eta_{7i} \Delta (OPENNESS)_{(t-i)} + \lambda_1 \ln FL_t + \lambda_2 (VOLI)_t + \lambda_3 (CMR)_t + \lambda_4 (REER)_t$$

$$+ \lambda_5 (LOIP)_t + \lambda_6 (OPENNESS)_t + \mu_t \quad \text{.....(5.1)}$$

*LSM* denotes economic activity, while *infl* is used for inflation, and exchange rate volatility is denoted by *voli* because exchange rate uncertainty is not directly observable. Further, it is

constructed using the GARCH model as explained in chapter 4. *CMR* denotes interest rate, *REER* denotes the real effective exchange rate, while *loilp* denotes oil prices and trade openness is represented by Openness. λ's demonstrates the long-run coefficients, whereas differenced variables are also estimated, whereas respective coefficients represent the short-run's impact.

**MODEL 2 & 3**

In these models, the misalignment has been used as an explanatory variable replacing REER, while the response variables are the same as used in **Model-1**.

The difference between **Model- 2** and **Model-3** is that in **Model-2,** the misalignment used is estimated by a simple regression framework, while in **Model-3,** the misalignment used is estimated by the ARDL method. Both types of misalignment calculation are explained in chapter 4, which has been used. The equation is given below:

$$\Delta \ln LSM_t = \eta_0 + \sum_{j=1}^{p} \eta_{1i} \Delta \ln LSM_{(t-j)} + \sum_{i=0}^{q} \eta_{2i} \Delta INFL_{(t-i)} + \sum_{i=0}^{q} \eta_{3i} \Delta (VOLI)_{(t-i)} + \sum_{i=0}^{q} \eta_{4i} \Delta (CMR)_{(t-i)} + \sum_{i=0}^{q} \eta_{5i} \Delta (MISREER)_{(t-i)}$$
$$+ \sum_{i=0}^{q} \eta_{6i} \Delta (LOIP)_{(t-i)} + \sum_{i=0}^{q} \eta_{7i} \Delta (OPENNESS)_{(t-i)} + \lambda_1 \ln FL_{(t-1)} + \lambda_2 (VOLI)_t + \lambda_3 (CMR)_t + \lambda_4 (MIS\ REER)_t$$
$$+ \lambda_5 (LOIP)_t + \lambda_6 (OPENNESS)_t + \mu_t \quad \text{.....(5.2)}$$

Misrer is used for misalignment of the exchange rate. All remaining variables are the same as in model 1. λ's demonstrate long-run coefficients, whereas differenced variables are attached with the short-run coefficients.

**Test for Non-linearity**

Before moving to the non-linear models, we will start with the test of non-linearity. The following tests for non-linearity are applied.

1. **Cusum test**
2. **McLeod and Li (1983) test**

**1. Cusum test**

Cusum tests evaluate the stability of coefficients in a model of multiple linear regression with the form $\mathbf{y} = \mathbf{X\beta} + \boldsymbol{\varepsilon}$. The basis for inference is a sequence of sums or sums of squares of recursive residuals (standardized one-step-ahead forecast errors) derived iteratively from nested subsamples of data.

**2. McLeod and Li (1983) test**

` By analyzing the Ljung-Box Q statistic of the squared residuals from an Autoregressive Moving Average (ARMA) representation, the McLeod and Li (1983) test for nonlinear dependency can be performed. Here, we employ the k autocorrelation coefficients $(\rho)$ to analyze the squared residuals $(e_t)^2$. Granger and Newbold (1986) test is used to confirm the hypothesis of serial correlation. If the series is linear, then.

$$\rho_e(K) = [\rho_e(k)]^2 \; for \; all \; k$$

In contrast, if they are unequal, nonlinearity is suggested. For the purpose of testing the independence hypothesis, the following formula can be used to determine the Ljung-Box Q-statistics.

$$Q_e(k) = n(n+2)\sum_{k=1}^{m}(n-k)^{-1}\rho_e^2\,(k)$$

where n is the total number of observations and $Q_e(k)$ represent the autocorrelation coefficient. The critical value $\tau$ obtained from Chi-square distribution at a given significance level with k degree of freedom. If $Q_e(k) > \tau$ , the null hypothesis of independence is rejected. It implies that the residuals time series is conditionally heteroscedastic (nonlinearly dependent).

**Non-Linear models**

**MODEL 4**

**Model-4** captured the nonlinear relationship between exchange rate and economic activity. However, this relationship is related to exchange fluctuations, both appreciation, and depreciation. Non-linearity is important because if series components are co-integrated

(positive and negative), hidden cointegration asymmetries might develop (Granger and Yoon 2002). Shin et al. (2014) introduced the NARDL model. It measures long-term cointegration and asymmetry. NARDL is a version of the autoregressive distributed lag (ARDL) model. Thus, the asymmetric nonlinear co-integrating equation is formulated. Decomposing the exchange rate into REER_POS and REER_NEG for the nonlinear ARDL model. REER_POS and REER_NEG indicate the accumulation of positive and negative change in REER, respectively.

$$REER\_POS = \sum_{j=1}^{t} \Delta REER_j^{+} = \sum_{j=1}^{t} \max(\Delta REER_j, 0) \text{.....(I)}$$

$$REER\_NEG = \sum_{j=1}^{t} \Delta REER_j^{-} = \sum_{j=1}^{t} \min(\Delta REER_j, 0) \text{.....(II)}$$

Since NARDL is defined as a model that decomposes REER into positive and negative changes, **Model-4** is used with the goal of capturing asymmetrical effects. Summarizing these equations (I, II), we get the NARDL equation, which looks like this.

$$\begin{aligned}\Delta \ln LSM_t = {} & \eta_0 + \sum_{j=1}^{p} \eta_{1i} \Delta \ln LSM_{(t-j)} + \sum_{i=0}^{q} \eta_{2i} \Delta INFL_{(t-i)} + \sum_{i=0}^{q} \eta_{3i} \Delta (CMR)_{(t-i)} + \sum_{i=0}^{q} \eta_{4i} \Delta (REER\_POS)_{(t-i)} + \\ & + \sum_{i=0}^{q} \eta_{5i} \Delta (REER\_NEG)_{(t-i)} + \sum_{i=0}^{q} \eta_{6i} \Delta (LOIP)_{(t-i)} + \sum_{i=0}^{q} \eta_{7i} \Delta (OPENNESS)_{(t-i)} + \sum_{i=0}^{q} \eta_{8i} \Delta (VOLI)_{(t-i)} \\ & + \lambda_1 INFL_t + \lambda_2 (CMR)_t + \lambda_3 (REER\_POS)_t + \lambda_4 (REER\_NEG)_t \\ & + \lambda_5 (LOIP)_t + \lambda_6 (OPENNESS)_t + \lambda_7 (VOLI)_t + \varepsilon_t \text{.....(5.3)}\end{aligned}$$

All variables are the same as explained above; only REER_POS denotes real appreciation, and REER_NEG represents real depreciation. λ's demonstrated long-run coefficients, whereas differenced variables are attached with the short-run coefficients.

**MODEL 5 & 6**

To achieve the desired objective of an analysis of combining exchange rate misalignment with fluctuation, we construct four cases. The detail of the construction of

cases is discussed in chapter 4. Out of these four, Case-II and Case-III are convergent as fluctuations will lead to an equilibrium exchange rate, while Case-I and Case-IV are divergent as fluctuations will lead away from equilibrium. The impact of fluctuations in the exchange rate moving toward the equilibrium level is expected to differ from when fluctuations are moving the exchange rate away from the equilibrium level. This also implies that policy ineffectiveness may occur due to analyzing misalignment and fluctuations separately on economic activity. Therefore, **Model-5** and **Model-6** have been constructed in which combinations of misalignments (undervalued / Overvalued) and exchange rate fluctuations (Appreciation / Depreciation) are used. The main difference between **Model-5** and **Model-6** is that the misalignment of the exchange rate used in **Model-5** is estimated by a simple regression framework, while that used in **Model-6** is estimated in the ARDL model (see Chapter 4 for more details). The combination in the model is presented as follows:

$$POS\_OVER = \sum_{j=1}^{t} \Delta LnRER_j^{+} + \sum_{j=1}^{t} MISRER_j^{+} = \sum_{j=1}^{t} \max(\Delta LnRER_j, 0) + \sum_{j=1}^{t} \max(MISRER_j, 0) \text{.....(i)}$$

$$NEG\_UNDER = \sum_{j=1}^{t} \Delta LnRER_j^{-} + \sum_{j=1}^{t} MISRER_j^{-} = \sum_{j=1}^{t} \min(\Delta LnRER_j, 0) + \sum_{j=1}^{t} \min(MISRER_j, 0) \text{.....(ii)}$$

$$POS\_UNDER = \sum_{j=1}^{t} \Delta LnRER_j^{+} + \sum_{j=1}^{t} MISRER_j^{-} = \sum_{j=1}^{t} \max(\Delta LnRER_j, 0). + \sum_{j=1}^{t} \min(MISRER_j, 0) \text{.....(iii)}$$

$$NEG\_OVER = \sum_{j=1}^{t} \Delta LnRER_j^{-} + \sum_{j=1}^{t} MISRER_j^{+} = \sum_{j=1}^{t} \min(\Delta LnRER_j, 0) + \sum_{j=1}^{t} \max(MISRER_j, 0) \text{.....(iv)}$$

Summarizing these equations(i to iv), we obtain the ARDL equation given as follows:

$$\Delta \ln LSM_t = \eta_0 + \sum_{j=1}^{p} \eta_{1i} \Delta \ln LSM_{(t-j)} + \sum_{i=0}^{q} \eta_{2i} \Delta INFL_{(t-i)} + \sum_{i=0}^{q} \eta_{3i} \Delta(VOLI)_{(t-i)} + \sum_{i=0}^{q} \eta_{4i} \Delta(CMR)_{(t-i)} +$$

$$\sum_{i=0}^{q} \eta_{5i} \Delta(POS\_OVER)_{(t-i)} + \sum_{i=0}^{q} \eta_{6i} \Delta(NEG\_OVER)_{(t-i)} + \sum_{i=0}^{q} \eta_{7i} \Delta(POS\_UNDER)_{(t-i)} + \sum_{i=0}^{q} \eta_{8i} \Delta(NEG\_UNER)_{(t-i)}$$

$$+ \sum_{i=0}^{q} \eta_{9i} \Delta(LOIP)_{(t-i)} + \sum_{i=0}^{q} \eta_{10i} \Delta(OPENNESS)_{(t-i)} + \lambda_1 INFL_t + \lambda_2 (VOLI)_t$$

$$+ \lambda_3 (CMR)_t + \lambda_4 (POS\_OVER)_t + \lambda_5 (NEG\_OVER)_t + \lambda_6 (POS\_UNDER)_t$$

$$+ \lambda_7 (NEG\_UNER)_t + \lambda_8 (LOIP)_t + \lambda_9 (OPENNESS)_t + \varepsilon_t \text{ .....} \quad (5.4)$$

POS_OVER denotes Case-I, which is overvalued with appreciation. NEG_OVER shows Case-II, which is overvalued and depreciated. POS_UNDER denotes Case-III, which is the appreciation of the exchange with undervaluation, and NEG_UNDER denotes Case-IV, which is undervalued with depreciation. All other variables are the same as discussed in model one, and the coefficient representation is also the same as explained above.

### 4.5.4 Definition and Construction of variables and Data Span

In order to achieve the desired objective, economic activity has been used as a dependent variable. In contrast, interest rate, inflation, oil prices, openness, the real effective exchange rate, misalignment, and constructed cases of a combination of fluctuations and misalignment have been used as explanatory variables.

It was noted that variables related to the index were measured on a different base year, like CPI, Tot, etc. In order to harmonize into the same base year, splicing or the common ratio method was used. This method finds a common year of indices of the different base years. Thus, a common ratio was found for the common year in which both variables were available. Then find the common ratio and change the base year. For consistency check, we can use the growth rate formula to find the previous value in the variable (i.e., $X_{t-1} = (\frac{100}{gr+100}) \times X_t$). It is mentionable that the base year in this study is 2010=100. Moreover, low-frequency (annual or quarterly) variables were transformed to monthly using linear, Litterman, and Chow-Lin methods, as discussed in Chapter 4.

### 5.4.1 LSM

In this research, LSM is used as a proxy for economic activity. PBS calculates Pakistan's LSM index from the Census of Manufacturing Industries (CMI) 2005-06, using 112 items with a total weight of 70.33 value-added units. The data is available on a monthly frequency. However, the base year of LSM was harmonized by other variables (2010=100)

by the splicing method. Thus, the year-on-year growth of LSM has been considered for economic activity in this research.

LSM is important in many areas of the economy, including employment, exports, and overall economic output. It is critical to investigate LSM to assess its impact on economic activity, trade dynamics, and other related factors. One notable aspect is its significant contribution to tax revenue, as the manufacturing sector, particularly in LSM, generates a sizable portion of government tax revenue. This money can be used for public investments, infrastructure development, social welfare programs and other necessities. Policy interventions and measures are frequently directed at the manufacturing sector to promote industrial growth, economic activity and competitiveness. Understanding the relationship between LSM and economic activity provides valuable insights for policymakers and aids in the development of effective economic development strategies. The study can assess the dynamic interplay between manufacturing, fiscal sustainability, and the country's competitive position in the global economy by considering the contribution of LSM to tax revenue and using it as a proxy for economic activity.

### 5.4.2 Interest rate

In its monetary policy, the State Bank of Pakistan uses interest rates (policy rates) to influence the economy to keep overall prices and financial markets stable. The SBP publishes Monetary Policy Statements and Decisions six times per year on its website. Moreover, to make monetary policy formation regular and transparent, the State Bank of Pakistan (SBP) publishes a semiannual calendar of Monetary Policy Committee (MPC) meetings. In an emergency, the frequency of Monetary Policy Committee (MPC) meetings may be increased. In this research, the frequency of the variable used in the analysis is on a monthly basis. Thus, the call money rate (CMR) is used as a proxy for the interest rate. At the same time, CMR is the rate on short-term loans among scheduled banks (ranging from overnight to fourteen days) that do not require collateral.

### 5.4.3 Inflation

In Pakistan, Consumer Price Index (CPI), Wholesale Price Index (WPI), and GDP deflator are used to measure inflation. However, in this research, the year-on-year growth rate in Consumer Price Index (General) is used to measure the inflation rate. It is also mentionable that presently CPI is measured on the base year 2007-08=100. Thus, to harmonize with the same base of 2009-10=100, the splicing method was used to convert the base year 2007-08=100 to 2009-10=100. Further, the growth of the consumer price index was used to measure inflation and was used as a variable in the research.

### 5.4.4 Oil Prices

For Pakistan, crude oil has a significant share in the import bill. In this study, the international price of crude oil is used. The data is available on monthly frequency and is available as $ per barrel. In this study, log of oil prices is used.

### 5.4.5 Trade openness

The most prevalent method used in literature for trade openness is the aggregate of exports and imports over GDP. Thus, exports and imports were taken as per the balance of payment data accessible on board and measured in a million dollars. The data is available on a monthly basis. It is also mentionable that data on GDP is available on an annual basis. Several studies have been conducted in order to get appropriate quarterly GDP estimates for Pakistan. Kemal & Arby (2004), Arby (2008), and Hanif et al. (2013) are notable examples. These studies aim to provide quarterly estimates on the expenditure-side components of the National Accounts.

Further, for the production side, the methodology of aggregation of subcomponents of the production side, i.e., agriculture, industry, and services, in accordance with their contribution to the real economy was followed. In this study, the Quaternization of GDP, both at constant

and current prices, was done by following Kemal & Arby's (2004) methodology. However, the Linear method available in EViews was used to convert the GDP into monthly.

### 5.4.6 Fluctuations

The exchange rate is a prime area of exploration; REER has been taken as the primary explanatory variable. In the linear model, REER and misalignment are used as explanatory variables. In order to capture the nonlinear effects, exchange rate series are classified as either positive changes or negative changes. Thus, NARDL, as per its usual methodology, is segregated into exchange depreciation (REER_POS) and exchange appreciation (REER_NEG).

### 5.4.7 Misalignment in Exchange Rate

The misalignment of the exchange rate series is divided into overvalued and undervalued exchange rates. Then four combinations of fluctuations and misalignment have been constructed as overvaluation with appreciation (POS_OVER), undervaluation with appreciation (POS_UNDER), undervalued with depreciation (NEG_UNDER), and overvalued with depreciation (NEG_OVER). The details of the construction of the cases is given in the previous chapter 4.

### 5.4.8 Exchange Rate Uncertainty

Uncertainty of exchange rate has been estimated through GARCH. Uncertainty about the exchange rate plays an essential role and highly impacts economic activity. Therefore, it is used in all models to analyze how much it impacts economic activity. The detail of constructing uncertainty is given in the previous chapter 4.

## 5.5 Results and Discussion

### 1) Unit Root Tests

It has been found that all variables are I (1) or I (0), while none of the variables is I (2). The Auto-Regressive distributed Lag (ARDL) model has been applied to the study of

both long-term and short-term relationships due to the fact that variables are integrated at various levels. The unit root results are shown in Appendix D

**2) Lag Length Criteria**

The appropriate selection of lag length is a prerequisite for the analysis. Any incorrect selection of lags may hinder or overfit the model (Stock & Watson, 2012). Using SIC (Schwarz information criterion) and AIC criteria, it has been found that the optimal lag length is 2, as shown in Table 5.1 (given in Appendix **D)**

### 5.5.1 Result of Bound Test

ARDL bound test results show the presence of cointegration among series. After estimating the long-run and short-run results, the bound test was used, as done by Pesaran et al. (2001). The results of the bound test presented in Table 5.1 show that F-statistic is greater than the lower and upper bound at a 1 percent significant level, so there is a long-run relationship between variables.

**Table – 5.1: Bound test**

| Test Statistic | | Value | Signif. | I(0) | I(1) |
|---|---|---|---|---|---|
| **Model 1** | **F-statistic** | 4.21 | 1% | 2.33 | 3.25 |
| **Model 2** | | 7.11 | 1% | 2.38 | 3.45 |
| **Model 3** | | 4.54 | 1% | 2.33 | 4.39 |
| **Model 4** | | 5.12 | 1% | 2.08 | 3.00 |
| **Model 5** | | 4.72 | 1% | 2.79 | 3.93 |
| **Model 6** | | 4.55 | 1% | 2.37 | 3.68 |

Source: Author Estimation

### 5.5.2 Long run results

**a) Linear Models**

The research has been done to investigate the relationship between economic activity and changes in the exchange rate along with its volatility, while for changes in the exchange rate, misalignment and fluctuations are considered. In this regard, initially, three linear models have been estimated. In these three linear models, the difference is that in **Model-1**, REER is used, while in **Model-2**, misalignment used has been estimated from a simple

regression framework. Finally, in **Model-3**, the misalignment used has been estimated by the ARDL model. Table 5.2 presents the results of long-run estimates from all linear models. The Dependent Variable is LSM, and independent variables are explained above. The coefficients and corresponding p-values are shown below in parenthesis.

**Table – 5.2: Long-run results (Linear Models)**

| | Model-1 | Model-2 | Model-3 |
|---|---|---|---|
| **LREER** | -0.129 | | - |
| | (0.038) | | |
| **MISREER** | | -0.367 | -1.658 |
| | | (0.033) | (0.571) |
| **CMR** | -0.022 | -0.018 | -0.045 |
| | (0.020) | (0.028) | (0.005) |
| **INFL** | 0.014 | 0.011 | 0.016 |
| | (0.021) | (0.060) | (0.020) |
| **OPENNESS** | -0.008 | -0.007 | -0.012 |
| | (0.172) | (0.182) | (0.067) |
| **LOIPPK** | 0.086 | 0.110 | 0.181 |
| | (0.089) | (0.024) | (0.019) |
| **VOLI** | -0.902 | -0.991 | -0.339 |
| | (0.001) | (0.001) | (0.024) |
| **TREND** | 0.003 | 0.012 | 0.003 |
| | (0.000) | (0.000) | (0.000) |

Dependent Variable: LSM
Source: Author Estimation

The results of **Model-1** show that there is a negative relationship between exchange rate fluctuations and economic activities. It has been found that keeping all other things the same, a one percent increase in REER will lead to an almost 13 percentage points decrease in economic activities, i.e., LSM growth. REER reflects a nation's international competitiveness relative to its trade partners. An increase in a country's REER means real appreciation implies that its exports are becoming more expensive while its imports are becoming cheaper, which in turn implies that the country is losing trade competitiveness. The inverse is the case when

REER depreciates. Similar findings of Faruqee (2004) that changes in exchange rates strongly impact both inflation and economic activity. The result is also consistent with Khalid (2015), Janjua (2007), and Hamid and Azka (2017). In these analyses, it was revealed that Pakistan had had a continually overvalued exchange rate. Further, overvaluation had an unfavorable influence on exports and the industrial sector. This has major negative effects in the long run, growth of the economy, combined with substantial short-term risk to the balance of payments crisis.

It is also found that interest rates negatively affect economic activities. It has been found that keeping all other factors the same, a one percent increase in interest rate leads to reduce the economic activities by two percentage points. The impact of interest rates on growth can be derived through investment channels. A high-interest rate and production are negatively related as these can cause investment to fall, possibly due to an increase in the cost of capital. Thus, there is a decrease in economic activities and hence economic growth. Further, one other interest rate channel is operating through housing and durable consumer goods. A similar finding of Sulaiman. et al. (2013), Hyder (2005), and Ahmad (2003), that investment has a significant inverse association with real interest rate and negatively impacts economic activities in Pakistan.

Inflation has a positive relationship with economic activities, similar to the finding of Hussain and Malik (2011) that inflation is necessary for Pakistan's economic growth but only within the single-digit range. However, Ayoub et al. (2011): Hussain (2008) and Manzoor (2005) found that prevailing inflation is harmful to the GDP growth of the economy after a certain threshold level. In this study, it was found that by keeping all other variables constant, a 1 percent increase in inflation results in a 1.4 percentage point increase in economic activity. An increase in inflation can have immediate as well as second-round effects. Due to a loss in purchasing power, households may demand higher wages, resulting in price-wage

feedback loops. These impacts contribute to a wage-price spiral and lead to upward revisions in inflation expectations. Thus, the positive relationship between inflation and economic activities, in the long run, is based on the hypothesis of the Phillips Curve, which asserts that high inflation has a positive effect on economic growth by contributing to a low unemployment rate. Further, Tobin Effect suggests that inflation motivates individuals to convert their liquidity into interest-earning assets, promoting capital accumulation and economic growth. Thus, inflation has a positive relationship with economic growth in the long run. Hence, the results suggest that if there is a rise in inflation, there will be positive growth in economic activities. The reason is that increased prices incentivize producers to more production in greed for more profit. Hence industrial production and economic activities accordingly increase. Further, increasing prices may also lead to growth through the aggregate demand channel. Theoretically, when an economy, as in the case of Pakistan, is not running at full capacity, i.e., when there are unused labor resources, inflation increases production. An increase in money supply results in increased expenditure, which increases aggregate demand. In response to increased demand, production increases to meet.

Trade openness was found to be inversely related to economic activities, which contradicts the findings of Mahmood et al. (2011) that exchange rate and GDP had a positive relationship while trade openness and FDI were negatively linked. However, our study is supported by the study by Wajahat and Azrai (2015) and Faiza (2014), which found that there is a lack of trade openness in Pakistan which is causing a negative and significant impact on economic growth in the long run. In this study, keeping all factors constant, a one percent increase in openness will lead to an almost 0.8 percentage points decrease in economic activities. The reason may be that Pakistan is among the countries with low financial development. Financial development helps economic growth by increasing the savings rate, mobilizing and pooling funds, creating investment information, facilitating and encouraging

foreign capital inflows, and optimizing capital allocation. Thus, openness has a negative relationship with economic activities; similar results are found by Kim et al. (2012) that in low-income countries, trade openness negatively affects the economy. Many studies suggest that financial sector development can promote trade openness's growth. In the previous two decades, developing and developed nations have had significant differences in financial development, usually measured by private credit to GDP. Financial development means improvement in financial sectors. Beck (2002) indicated that nations with developed financial sectors have a manufacturing edge since financing the sector's fixed expenses is cheaper. Financial growth reduces financial frictions, which boosts productivity and shifts trade toward capital-intensive industries. Due to less-developed financial sectors, there is a negative association between trade openness and economic activities in Pakistan. By and large, financial sector efficiency has grown in Pakistan as a result of the deregulation of the sector that began in the late 1980s. Comparatively, Pakistan's financial sector is small and plays a minimal role in financing the private sector.

Further, it has been found that oil prices positively and significantly impact economic activities. The result is similar to the findings of Afia (2010) and Ahmed (2013), which found that oil prices and output are found to be strongly related, and to a great extent, this relationship is non-linear. However, Sidra and Qayyum (2014) found that Oil prices impact real GDP negatively in the long run but positively in the short run. Further, there is evidence of causality between Oil consumption (including sectors) and economic growth. In our study, it was found that keeping all other things the same, a one percent increase in international oil price will lead to a 0.09 percentage points increase in economic activities. The positive relationship between international oil prices and economic activities is because the government usually does not translate the increase in international oil prices into domestic prices. Thus, agents realize the expected future price increase in their production activities.

One other reason could be that a rise in oil prices generates income for oil exporting countries, and because the majority of remittances in Pakistan are from these countries, significant growth in remittances has occurred, which is translated into consumption. The rise in consumption will increase domestic demand and hence economic activities. Regarding oil prices, it is mentionable that oil is a necessary input for many industrial productions. Theoretically, an increase in oil prices may increase economic activities in oil-producing countries. Thus, for Pakistan, either it is beneficial through workers' remittances, or an increase in oil prices will lead to the growth of economies (trading partners), thus leading to more demand for imported goods by these countries, which leads to an increase in exports of Pakistan. However, an increase in oil prices will increase input cost and hence prices; producers will respond to increase output considering the profit function homogenous of degree one in output as discussed above. Thus, increasing oil prices will lead to increased economic activities and growth.

Finally, volatility (uncertainty) of the exchange rate negatively and significantly affects economic activities. These findings are consistent with those of Anjum and Nishat (2006) and Zahoor and Farooq (2009), who also discovered that, over the long term, domestic economic performance is extremely sensitive to the volatility of the exchange rate. Thus, our study also suggests that an increase in uncertainty will hamper economic activities. Keeping all other things constant, a one percent increase in volatility of the exchange rate will lead to a 0.9 percentage points decrease in economic activities. The reason is that uncertainty is related to expectations of producers' decisions about production, and our uncertainty result revealed that at the time of the election, the uncertainty increased in the economy. When the government changes in the country, people are relucent to invest and hold money which affects economic activities. Thus, in high uncertainty, the producers halt production based on two channels. One is through exports because producers are unclear about the prices of their

products in international markets and gain from these exports. Secondly, through imports, uncertainty leads them to avoid contracts based on an increase in input prices, mostly imported goods.

In **Model-2**, REER was replaced by misalignment. It is found that misalignment is negatively and significantly affecting economic activity. Suppose a one percentage point increase in misalignment of the exchange rate will lead to a 3.7 percentage points decrease in economic activity. It implies that when the exchange rate is misaligned, agents become uncertain about the stability of the domestic currency. The possible reason is that misalignment of the exchange rate dampens investment due to the increased cost of imported intermediate goods and the user cost of capital. Businesses invest until the marginal return on investment equals the cost of funding the project (the marginal cost of capital). This means shocks to either value will alter companies' investment behavior. Changes in the exchange rate affect present and expected earnings, aggregate demand, factor productivity, competitiveness, and, ultimately, investment decisions.

In terms of CMR, the findings show that it has a significant and negative impact on economic activity. For inflation in this model, a positive relationship with economic activity was found, while there exists a negative relationship between trade openness and economic activity. Furthermore, it has been found that oil prices have a positive and significant relationship with economic activity. The positive impact of oil prices in this model is justified because the impact of oil is more significant when the exchange rate is misaligned. If the exchange rate is undervalued, an increase in international market oil prices has no effect on the domestic economy, and people invest more and use more oil to produce goods, potentially increasing demand for goods and services. The uncertainty of the exchange rate has a negative and significant impact on economic activity. It implies that rising uncertainty will hamper economic activity.

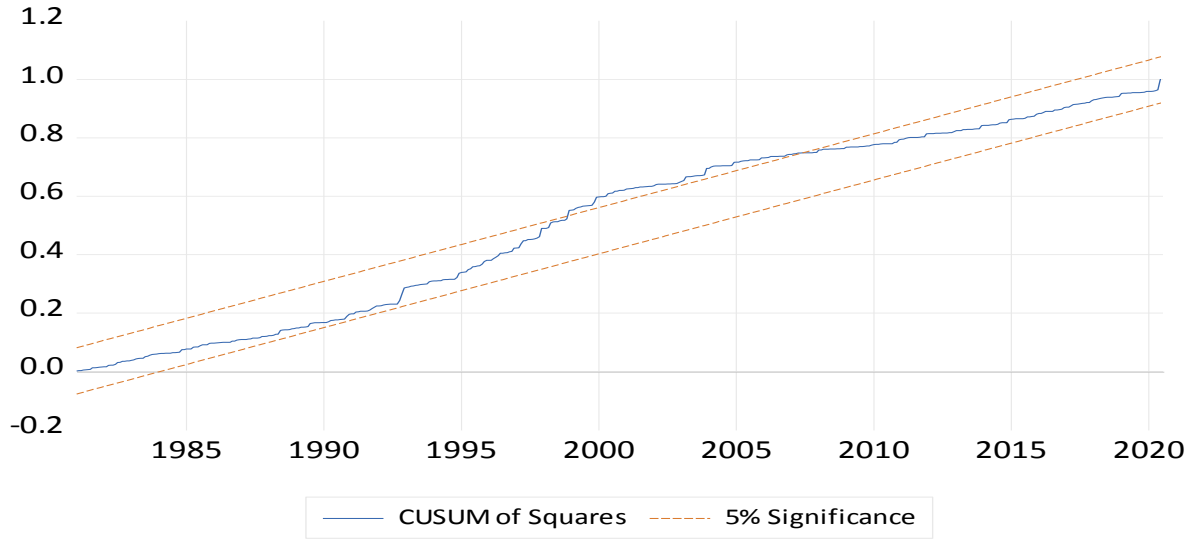
In **Model-3**, the misalignment used has been estimated by the ARDL model. While comparing the coefficients of misalignment in **Model-2** and **Model-3**, it is found that the coefficient of misalignment measured in the ARDL model is higher but insignificant than that of misalignment found by the simple regression framework. In terms of the relationship between economic activity and explanatory variables, the results are similar for all other variables found in **Model 2**.

As mentioned earlier, before moving to a non-linear model, linearity tests were conducted. The results are presented below:

**Structural Stability test**

The parameters' stability is checked through CUSUM and CUSUM square tests. The results showed that model 1 is not stable. Fig – 5.1 revealed that the blue line is not within the boundary of a 5 percent level of significance, so it is concluded that the model is not linear.

***Fig -5.1: CUSUM square tests***




**McLeod and Li (1983) test**

The result of the McLeod and Li (1983) test is given in Appendix E. The **Q** statistics is significant, which shows that the model is a nonlinear model**.**

**Nonlinear models**

In the nonlinear models, **Model-4** is estimated by incorporating positive and negative changes in REER. In contrast, the combination of misalignment and fluctuations by constructing four cases (as discussed earlier) was used in **Model-5** and **Model-6**. In **Model-5**, misalignment used in cases was estimated by a simple regression framework, and in **Model-6,** misalignment used in cases was estimated by the ARDL model. The volatility of exchange rates was also used as an explanatory variable in all nonlinear models. The results are presented in Table 5.3 dependent variable is economic activity (lsm) and the coefficients and corresponding p-values of independent variables are shown in the table below in parenthesis.

**Table – 5.3: Long-run results (Nonlinear Models)**

| | **Model-4** | **Model-5** | **Model-6** |
|---|---|---|---|
| **LREER_POS** | -0.803 | | |
| | (0.001) | | |
| **LREER_NEG** | 0.182 | | |
| | (0.011) | | |
| **POS_OVERVAL** | | -1.438 | -0.858 |
| | | (0.000) | (0.001) |
| **NEG_OVERVAL** | - | 0.269 | 6.407 |
| | | (0.052) | (0.000) |
| **POS_UNDERVAL** | | 0.687 | 1.594 |
| | | (0.000) | (0.061) |
| **NEG_UNDERVAL** | | -0.277 | -0.772 |
| | | (0.032) | (0.015) |
| **CMR** | -0.012 | -0.014 | -0.028 |
| | (0.010) | (0.005) | (0.002) |
| **INFL** | 0.012 | 0.011 | 0.018 |
| | (0.000) | (0.007) | (0.182) |
| **OPENDESE** | -0.013 | -0.020 | -0.009 |
| | (0.000) | (0.000) | (0.102) |
| **LOIPPK** | 0.128 | 0.109 | 0.303 |
| | (0.000) | (0.000) | (0.000) |
| **VOLI** | -0.091 | -0.083 | -0.150 |
| | (0.065) | (0.061) | (0.002) |

Dependent Variable: LSM
Source: Author Estimation

In **Model-4**, REER is decomposed into positive and negative changes to capture the nonlinear relationship of the exchange rate with economic activity. The results show that positive changes in REER negatively and significantly affect economic activity, while negative changes in REER are significant and positively affect economic activity. It is mentioned that negative changes in REER will enhance export competitiveness. Thus, exports will become cheaper to foreigners. In turn, industrial production will increase, thus enhancing economic activity. Exchange rate appreciation negatively affects the economy. Thus, an increase in REER (appreciation in the exchange rate) of a country enables foreign firms and consumers to pay more for the exported goods due to higher purchasing power as exports increase, while domestic consumers pay less for the imported goods. If the investment is inefficient, then eventually decrease in production leads to reduced economic activity. Thus, net exports decline in the long run due to low economic activity. The impacts of other explanatory variables on economic activity remained similar in all models, except variation in magnitude is observed (Table 5.2). The interest rate, openness, and volatility are negatively affecting economic activity in Model-4, while inflation and oil prices are positively affecting economic activity.

In **Model-5**, the direction of variations in the exchange rate with respect to the equilibrium level determines the nature of the relationship between the exchange rate and economic activity. Convergent cases are positive, while divergent cases negatively affect economic activity. In the case of depreciation with undervaluation, it reduces economic activity as its coefficient is significant. While depreciation with overvaluation will lead to an increase in economic activity, and undervaluation with appreciation leads to an increase in economic activity. Thus, convergent cases (Case-II & III) positively and significantly impact growth. Likewise, divergent cases (Case-I & IV) have a negative and significant impact on growth. In convergent cases, whether appreciation or depreciation of the exchange rate, the

movement is towards equilibrium, which addresses misalignment and reduces internal and external imbalances. The reduction in internal and external balances helps in rebuilding business and market confidence. This increase in investment in tradeable goods helps accelerates economic activity. Thus, when the exchange rate is moving toward equilibrium, uncertainties are removed, thus giving credibility and building the confidence of local and foreign investors. Thus, economic activity increases through an increase in domestic investment as well as foreign direct investments (Ozkan and Erden, 2015).

In divergent cases, the exchange rate movement is away from equilibrium due to intensified internal and external imbalances. Thus, economic activity is negatively affected in divergent cases. The reason is based on the behavior of agents. They realize that the exchange rate is becoming away from its equilibrium level. Thus, they pull out investment and halt production. Thus, when the exchange rate diverges from the equilibrium in which market uncertainties are intensified, which pauses the investment decision. The results of our research are supported by the findings of Rodrik (2008) and Wong (2013). In comparison, Rodrik (2008) found that an undervalued currency (high real exchange rate) supports economic growth, especially in developing economies, while Wong (2013) found that a rise in real exchange rate misalignment will reduce economic growth. The other explanatory variables, CMR, Openness, and uncertainty, are negatively and significantly related to economic activity, while oil prices and inflation are positively and significantly related to economic activity.

In **Model-6**, the results are similar to those found in **Model-5** regarding impact and direction. In the case of depreciation with undervaluation, it negatively affects economic activity, while undervaluation with appreciation leads to an increase in economic activity. Thus, convergent cases (Case II & III) have a positive impact on economic activity, while divergent cases (Case-I & IV) have a negative and significant effect on economic activity. In

both cases, the magnitude of estimated coefficients is higher in **Model-6** than in **Model-5**. In **Model-6**, misalignment is used by estimating by the ARDL method. Thus, if the exchange rate is undervalued and appreciation leads to equilibrium, it becomes small yet still hurts economic activity. If a exchange is overvalued and depreciated to bring it back to balance, it boosts economic activity. Economic agents are optimistic about the economy's future. Thus, they increase investment and production, which in turn boosts economic activity.

Regarding other explanatory variables, the results found in **Model-5** and **Model-6** are similar to the results found in **Model-4.** Interest rates and openness are negatively related, while inflation and oil prices are positively related to economic activity. Economic activity is negatively affected by uncertainty in all nonlinear models.

It is concluded that we started with the discussion that Fluctuations (Depreciation / Appreciation) and Misalignment (Undervalued / Overvalued) are used separately in the literature, which biased results and policy implications. This point is significantly justified by comparing the results of linear and nonlinear models. In Linear Model, it is found that fluctuations (REER), well as Misalignment, negatively affect economic activity. But in Nonlinear Model, in case of even fluctuations, results were different when distributed into LREER_POS (appreciation) and LREER_NEG (depreciation). Economic activity is negatively linked with appreciation (LREER_POS) and positively linked with depreciation (LREER_NEG). Same we found in the case of the combination we used for Fluctuations and Misalignment. Case-I (Overvaluation with appreciation) and Case-IV (Undervaluation with depreciation) are negatively related to economic activity, while Case-II (Overvaluation with depreciation) and Case-III (Undervaluation with appreciation) are positively related to economic activity.

### 5..5.2 Short run Results of ARDL Models

**a) Linear model results**

The ARDL model gives us both short-run and long-run results, which are presented in Table 5.4. It has been found that the lag of the response variable is significant, implying that any change that occurs in the last month will impact economic activity in the current month. However, the negative sign in all models implies that if there is a high growth of economic activity in the previous period, the growth will decline in the current period. The performance of economic activity is dependent on fiscal and monetary policies and international factors like regional competitiveness. Thus, rupee depreciation and contractionary monetary and fiscal policies related to austerity measures, especially during any IMF programs, will also lower the economic activity growth rate and vice versa. Thus, the performance of economic activity in one period is also dependent on economic activity that happened in the previous period, and the policy taken last month will spill over effect in the coming months. The coefficients and corresponding p-values are shown below in parenthesis.in table 5.4.

**Table – 5.4: Short-run results (Linear Models)**

| | Model-1 | Model-2 | Model-3 |
|---|---|---|---|
| **LREER** | -0.014 | | |
| | (0.387) | | |
| **MISRER (-1)** | | -0.042 | -0.136 |
| | | 0.039 | 0.582 |
| **INFL** | | | 0.001 |
| | | | (0.056) |
| **LLSM (-1)** | -0.110 | -0.115 | -0.082 |
| | (0.000) | (0.000) | (0.002) |
| **CMR (-1)** | -0.002 | -0.002 | -0.004 |
| | (0.009) | (0.010) | (0.000) |
| **INFL** | | | 0.001 |
| | | | (0.056) |
| **VOLI** | -0.110 | -0.114 | -0.028 |
| | (0.001) | (0.000) | (0.004) |
| **LOIPPK (-1)** | 0.010 | 0.013 | 0.015 |
| | (0.096) | (0.021) | (0.008) |
| **OPENNESS (-1)** | -0.001 | -0.001 | -0.001 |

| | | | |
|---|---|---|---|
| | (0.201) | (0.196) | (0.084) |
| **INFL (-1)** | 0.002 | 0.001 | |
| | (0.047) | (0.092) | |
| **D (LLSM (-1))** | -0.434 | -0.472 | -0.471 |
| | (0.000) | (0.000) | (0.000) |
| **D (LLSM (-2))** | -0.222 | -0.291 | -0.300 |
| | (0.000) | (0.000) | (0.000) |
| **D (LLSM (-3))** | | -0.124 | -0.164 |
| | | (0.007) | (0.001) |
| **D (LLSM (-4))** | | -0.120 | -0.191 |
| | | (0.004) | (0.000) |
| **D(CMR)** | -0.002 | | -0.001 |
| | (0.095) | | (0.261) |
| **D (CMR (-1))** | -0.002 | | 0.001 |
| | (0.099) | | (0.469) |
| **D (CMR (-2))** | | | 0.003 |
| | | | (0.012) |
| **D (OPENDESE)** | -0.008 | -0.008 | |
| | (0.000) | (0.000) | |
| **D (OPENDESE (-1))** | -0.005 | -0.005 | |
| | (0.000) | (0.000) | |
| **D (OPENDESE (-2))** | -0.003 | -0.003 | |
| | (0.001) | (0.001) | |
| **D(LOIPPK)** | 0.090 | 0.096 | 0.100 |
| | (0.000) | (0.000) | (0.000) |
| **D (LOIPPK (-1))** | 0.035 | 0.039 | 0.034 |
| | (0.166) | (0.104) | (0.173) |
| **D (LOIPPK (-2))** | 0.036 | | |
| | (0.136) | | |
| **D(INFL)** | -0.001 | -0.002 | |
| | (0.530) | (0.418) | |
| **D(MISRER)** | | 0.043 | |
| | | (0.463) | |
| **D (MISRER (-1))** | | -0.144 | |
| | | (0.009) | |
| **C** | -0.498 | -0.602 | 0.006 |
| | (0.051) | (0.011) | (0.954) |
| **TREND** | 0.000 | 0.000 | 0.000 |
| | (0.004) | (0.003) | (0.045) |
| **ECM** | -0.045 | -0.115 | -0.079 |
| | (0.000) | (0.000) | (0.000) |
| **Durbin-Watson stat** | 1.96 | 1.95 | 1.99 |
| **AIC** | 0.854 | 0.812 | 0.785 |
| **SBC** | 1.162 | 1.131 | 1.025 |

Dependent Variable: LSM, (The corresponding p-values of coefficient are shown below in parenthesis.)
Source: Author Estimation

The result of Model-1 showed that the REER coefficient is negative and insignificant, implying that REER has a negative short-run impact on economic activity. The interest rate negatively impacts economic activity in the short run, while the current inflation growth rate is detrimental to economic activity. In the short run, international oil prices positively affect economic activity. One possible explanation is that, despite rising oil prices, consumption is not decreasing. It could be due to rising oil demand, a shift in oil consumption structure, and

an increase in other uses of oil, such as vehicle fuel. There may be a positive relationship between economic activity and oil prices. Finally, in the short run, openness has a negative impact on economic activity.

Likewise, in Model-2, the results showed that in the short run, misalignment of the exchange rate is negatively related to economic activity, while in Model-3, misalignment of the exchange rate has a negative relationship with economic activity, but the coefficient is insignificant. It is also mentionable that the short-run impact of other explanatory variables on economic activity is similar to the results found in Model-1. Based on the Akaike information criterion (AIC) and Schwarz Information criterion (SIC), Model-3 seems the best fit. The coefficients and corresponding p-values are shown in the table below in parenthesis.

**b) Nonlinear model short run**

**Table – 5.5: Short-run results (Nonlinear Model)**

| | Model-4 | Model-5 | Model-6 |
|---|---|---|---|
| **LREER_POS** | -0.171 | | |
| | (0.004) | | |
| **LREER_NEG** | 0.039 | | |
| | (0.013) | | |
| **POS_OVERVAL** | | -0.275 | -0.088 |
| | | (0.001) | (0.040) |
| **NEG_OVERVAL** | | 0.052 | 0.659 |
| | | (0.041) | (0.011) |
| **POS_UNDERVAL** | | 0.053 | 0.164 |
| | | (0.014) | (0.021) |
| **NEG_UNDERVAL** | | -0.131 | -0.079 |
| | | (0.003) | (0.068) |
| **LLSM (-1)** | -0.213 | -0.191 | -0.103 |
| | (0.000) | (0.000) | (0.000) |
| **CMR (-1)** | -0.003 | -0.003 | -0.003 |
| | (0.009) | (0.001) | (0.000) |
| **INFL** | 0.003 | 0.002 | 0.001 |
| | (0.001) | (0.027) | (0.269) |
| **VOLI** | -0.019 | -0.016 | -0.015 |
| | (0.063) | (0.108) | (0.031) |
| **LOIPPK (-1)** | 0.027 | 0.021 | 0.031 |
| | (0.000) | (0.002) | (0.001) |
| **LOPEN (-1)** | -0.003 | -0.004 | -0.001 |
| | (0.002) | (0.000) | (0.212) |
| **D (LLSM (-1))** | | -0.304 | -0.407 |
| | | (0.000) | (0.000) |
| **D (LLSM (-2))** | | -0.159 | -0.229 |
| | | (0.000) | (0.000) |
| **D(CMR)** | -0.002 | | |
| | (0.045) | | |
| **D (CMR (-1))** | -0.001 | | |
| | (0.526) | | |
| **D (CMR (-2))** | 0.002 | | |

| | | | |
|---|---|---|---|
| | (0.055) | | |
| **D(OPENDESE)** | -0.008 | -0.007 | -0.008 |
| | (0.000) | (0.000) | (0.000) |
| **D(LOIPPK)** | 0.112 | 0.092 | 0.117 |
| | (0.000) | (0.000) | (0.000) |
| **C** | 0.449 | | |
| | (0.000) | | |
| **TREND** | 0.002 | | |
| | (0.000) | | |
| **ECM** | -0.225 | -0.117 | -0.113 |
| | (0.000) | (0.000) | (0.000) |
| **Durbin-Watson stat** | 1.97 | 1.94 | 1.99 |
| **AIC** | 0.844 | 0.830 | 0.805 |
| **SBC** | 1.144 | 1.112 | 1.003 |

Dependent Variable: LSM
The corresponding p-values of coefficient are shown below in parenthesis
Source: Author Estimation

**Model-4 is** estimated by decomposing REER into negative and positive changes of REER. The result showed that real appreciation negatively affects economic activity, and the results are significant. At the same time, real depreciation positively and significantly affects economic activity in the short run. Other explanatory variables showed that interest rate, openness, and uncertainty negatively affect economic activity. However, inflation and oil prices are positively related to economic activity.

**Models-5 and Model-6** are estimated by combining misalignment with fluctuations in the exchange rate. The four cases, as discussed above, are incorporated into estimation along with other macroeconomic explanatory variables. The results show that in both models (**Model-5 and Model-6**), divergent cases, Case-I (Overvaluation with appreciation) and Case-IV (Undervaluation with depreciation), have adverse and significant effects on economic activity. Although both models use different misalignments, there is no change in the impact, but the magnitude of the coefficients in both models is different. The reason is that in the short run, the government decided to keep overvalued exchange rate based on the performance of the external sector and the level of foreign reserves. Thus, if foreign reserves are sufficiently well above the adequacy level along with strong capital inflows, the overvalued exchange rate will not let the exchange rate depreciate because of central bank

intervention. However, this exchange rate appreciation will increase the demand for foreign goods (imports) while the demand for domestic goods will fall. Thus, negatively affecting economic activity.

Further, most of the time, the external sector is exposed to the international situation, then a depressed international economic situation can adversely affect exports and thus depreciate the domestic currency. Further, if foreign reserves have started depleting, investment decisions will go on hold or may decrease, thus, adversely affecting economic activity. In Pakistan, like in other countries, exports are a source of foreign reserves and a significant source of economic activity. Though exports have a small share of GDP, any poor performance of exports might lead to a further shortage of foreign reserves, which may hamper economic growth overall. In divergent cases, since the exchange rate is moving away from equilibrium, thus, economic activity is negatively affected due to intensified internal and external imbalances.

Regarding convergent cases (whether overvalued and depreciation or undervalued and appreciation) positively and significantly impact economic activity. The positive effect is due to the fact that the agents realize that the economy is out of macroeconomic imbalances and currency crises. It happened based on building reserves and bridging financing gaps. Thus, investments start increasing because of increased domestic demand and exports. Hence, positively impacting economic activity. Considering the behavior of agents when the exchange rate is moving toward equilibrium, uncertainties are removed. Thus, giving creditably and building the confidence of local and foreign investors. Thus, economic activity increases through an increase in domestic investment as well as foreign direct investments (Ozkan and Erden, 2015).

Regarding other explanatory variables, it is found that the interest rate negatively and significantly affected economic activity. The reason is that decision to invest changes with

the change in interest rate, thus affecting economic activity in the current period. Contrary to interest rate behavior, inflation is found to affect economic activity positively and significantly. Further, inflation is related to the current level of economic activity, aligned with Bredin et al. (2003). In the case of uncertainty, it is found that it negatively and significantly affects economic activity on account of agents' behavior in response to uncertainty. As mentioned in chapter 4, the uncertainty of the exchange rate is strongly linked to the political scenarios in the economy. In each election time or change in government time, the uncertainty increases in the economy, negatively affecting the business decision. It affects economic activity overall.

Regarding Oil prices, it is found that these positively and significantly affect economic activity in all models. Oil prices impact real GDP positively in the short run. This result is consistent with other studies (Rasmussen and Roitman, 2011, Sidra and Qayyum, 2014). The reason is that oil is a necessary input in almost all economic activity. In International literature, Jayaraman and Lau (2011) showed that the commodity price boom with rising oil prices had brought considerable economic growth. Thus, increasing oil prices will not make producers alter their production in the short run. Further, an increase in oil prices in the international market may not fully translate into the domestic market. It has been found historically that the government used to provide subsidies in order to maintain domestic crude oil prices to avoid inflationary pressures. Thus, even if there is an increase in international oil prices, economic activity within the economy increases in the short run. Kurihara (2015) also found that rising oil prices impact the economy positively. Aliyu, (2009) shows that oil prices are positively related to economic growth.

Openness is found insignificant in all linear models but significant in nonlinear models except the nonlinear model in which misalignment estimated by ARDL has been used. However, in all models sign of the coefficient remained negative, implying that there is

a negative relationship between openness and economic activity mainly because, in Pakistan, trade liberalization policies are still not fully implemented as the process of financial development is slow. Based on both the Akaike information criterion (AIC) and the Schwarz Information criterion (SIC), Model-6 seems the best fit.

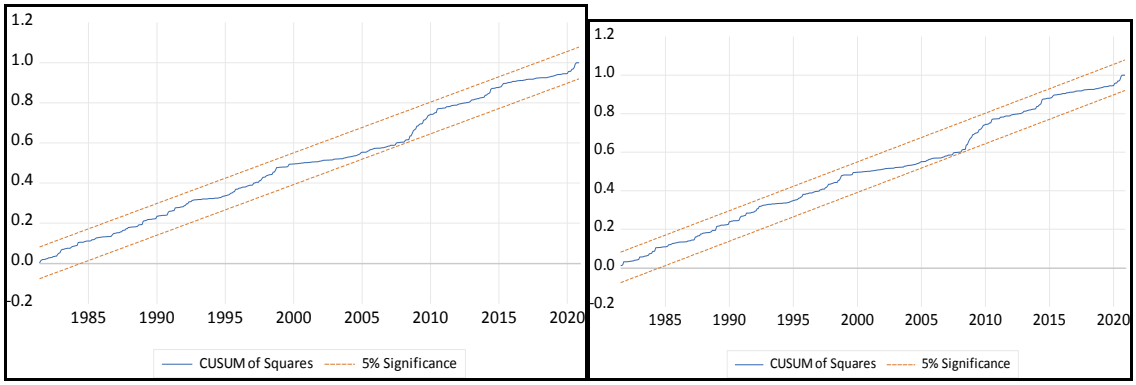
### 5.5.3 Error Correction Model

ECM explains the series' short-run dynamics. It indicates the series' speed of adjustment to long-run equilibrium. A relatively Significant and negative coefficient of ECM confirms a robust long-run association, citing Banerjee et al. (1993). Tables 5.3 and 5.4 demonstrate that the ECM coefficient is negative and statistically significant at the 1% level, indicating a consistent long-run association between variables. The results of all models recommend applying that in the short term, the system returns to long-run equilibrium after experiencing temporary fluctuations at roughly 4.5%,11.5%, 7.9%, 22.5%, 11.7%, 11.3% every month.

### 5.5.5 Structural Stability Test

Brown et al. (1975) proposed that in the case of a simple regression framework, the CUSUM and CUSUM square tests be used to determine the model's parameter stability and the accuracy of the estimated models. Graphs of CUSUM square corresponding to ARDL models are shown in Fig – 5.3 (a, b). The CUSUM test assesses the stability of coefficients in a multiple linear regression model. The inference is based on a sequence of sums or sums of squares of recursive residuals (standardized one-step-ahead forecast errors) computed iteratively from nested sub-samples of the data. Under the null hypothesis of coefficient constancy, values of the sequence within an expected range of a 5% level of significance or two standard errors indicate the stability of the coefficient.

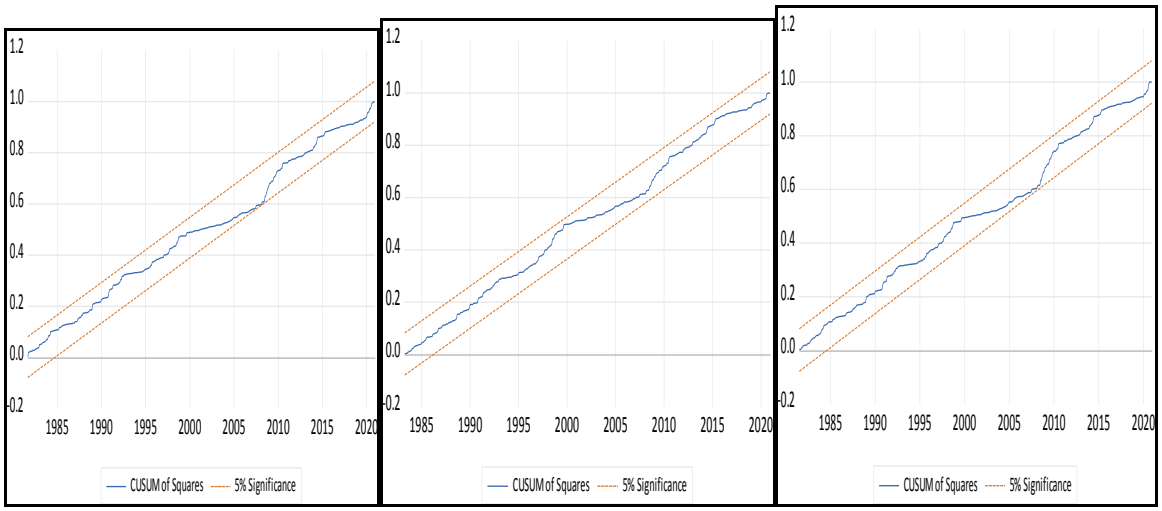
**Linear Model**
**Fig 5.3 a: CUSUM square plot ARDL**




Source: Author Estimation

**Nonlinear Model:**

**Fig 5.3 b: CUSUM of Nonlinear ARDL**




Source: Author Estimation

## 5.6 Conclusion

This research uses linear and nonlinear models to explore the relationship between exchange rates and economic activity. This makes it possible for us to differentiate the policy implications derived from linear models from those derived from nonlinear models. It is important to note that in linear models, the dynamic impact is harmonized due to aggregation, which may not have consistent policy implications, especially in more volatile scenarios.

Thus, the nonlinear ARDL model has been estimated after constructing four cases based on exchange rate misalignment (overvalued/undervalued) combined with fluctuation(appreciation/depreciation). The ARDL model provides both long un and short-run estimates. These models use interest rate, Inflation, Oil Prices, Uncertainty, REER, misalignments, and trade openness as explanatory variables. In linear models, it has been revealed that fluctuations in the exchange rate and misalignments of the exchange rate, when

employed separately, have a negative impact on economic activity. But nonlinear **Model-4** showed that real appreciation negatively influences economic activity while real depreciation has a positive effect. In addition, in the nonlinear models **Model-5** and **Model-6**, the combination of misalignment and fluctuations is used by making four cases. The results showed that convergent cases are positively related to economic activity. On the other hand, divergent cases have a negative impact on economic activity.

The results found that interest rate, trade openness, and uncertainty are negatively related to economic activity in all linear as well as nonlinear models, while inflation and oil prices are positively related. This implies that an increase in interest rate can hamper growth through a decrease in investment, and the same is true with uncertainty. The more uncertainty of the exchange rate, the lesser will be an investment made by producers. Regarding trade openness, it is negatively related to economic activity, implying that growth will be restricted through aggregate demand as openness leads to a decrease in net exports by increasing imports more than an increase in exports.

# Chapter 6

## Effect of Exchange Rate Variability on Prices: A Linear and Nonlinear Analysis

### 6.1 Introduction

Price stability is one of the primary goals of any macroeconomic policy. In recent literature, it was found that exchange misalignments and fluctuations led to disequilibrium in the money markets, thus impacting price stability. Earlier, the focus remained on finding determinants of inflation for determining policy effectiveness. Thus, in literature, many determinants of inflation were discussed, but Dornbusch (1987) was the first to explain the link between the exchange rate and inflation. Presently, studies are being conducted to explore the relationship between variations in exchange rate fluctuations on inflation.

It is worth mentioning that exchange rate fluctuations and misalignments both influence business and consumer purchasing power, thus affecting their real income. Thus, prioritizing the requisite macroeconomic policies especially related to the exchange rate, to maintain the price level and control inflation. It is argued that when an exchange rate appreciates, inflationary pressures are reduced on account of less expensive imports, Thus, attracting more imports and reducing demand for domestic goods which eventually lowers inflation. Conversely, an overvalued exchange rate is especially problematic during periods of sluggish economic growth, while in a booming economy, the overvalued exchange rate can help in decreasing inflationary pressure. The reason being local businesses reduce expenses and boost output to remain competitive.

Calvo et al. (1995) noted that a strategy aimed at depreciating the real exchange rate is accompanied by a combination of greater inflation and rising real interest rates, with the latter dependent on the lack of capital mobility. Conversely, when there is perfect capital mobility in countries, especially those which are already facing inflation, the real exchange rate must be adjusted to maintain international competitiveness. Further, in addition, rising internal and

external imbalances usually compel the government to tighten its budgetary policy. Thus, a decrease in government borrowing helps in reducing inflationary pressures. However, if the budget deficit is financed through domestic and external debt, the economy may experience extreme inflationary pressures.

Like economic activity discussed in the previous chapter, it is hypothesized that the impact of exchange rate on prices will be different by using a combination of fluctuations and misalignments from that if estimated from fluctuations and misalignment separately. There is the possibility that the impact of fluctuation moving the exchange rate away from equilibrium on prices will be different than those if the exchange rate is moving toward equilibrium. Therefore, there is a need to use a combination of fluctuations and misalignments in analyzing the impact of the exchange rate on prices for proper policy implications.

Hence, determining the linear and nonlinear effects on prices by combining exchange rate misalignments and fluctuations is the third goal of this study. Thus, to estimate the impact of the exchange rate on prices, prices are used as a response variable. In contrast, this study takes misalignment and fluctuations of the exchange rate in four cases as the main variables of concern. Moreover, control variables have been used as interest rate, income, oil prices, money supply, fiscal deficit, volatility, and real effective exchange rate. Further, for analysis, both linear and nonlinear models are estimated. The linear models estimated through ARDL establish short-run and long-run relationships between explanatory and response variables. However, one conventional NARDL model is estimated, and two for the extended NARDL model, in which misalignments and fluctuations are combined by constructing four cases, as discussed earlier, have been used.

### 6.2 Conceptual Framework

Policymakers are always worried about inflation because it reduces real income by reducing the purchasing power of consumers. Further inflation affects future savings, which

in turn affects future investment and income. Thus, inflation produces inefficiencies in economic growth through decisions on saving and investment. Inflation is considered one of the central problems countries face today. It affects macroeconomic stability by reducing savings and contracting investments, growth, and exports (Korkmaz, 2010). In literature, there are different variables causing inflation, but the exchange rate is considered a critical variable, especially in emerging economies. Thus, it is described that exchange rates affect prices directly and indirectly (Hendry, 1980). The direct impact is through demand. Exchange rate fluctuations change the demand for imported and domestic goods, thus affecting product prices. The indirect impact is through cost. Thus, fluctuations in exchange rates are transferred to domestic prices via the cost of production of imported goods. It has been found that whenever the exchange rate falls, local products become cheaper to global customers, boosting exports and domestic prices. Depreciation, for example, makes imported goods more expensive, increasing demand for domestic goods and increasing domestic inflation, keeping other things the same. Further, the cost-push and demand-pull inflation is explained through the aggregate supply and demand channels as well.

***Cost-push*** inflation is due to a change in one or more of the determinants of supply leading to a change in supply which eventually affect the price level in the economy. The exchange rate, one of the significant determinants of supply, strongly affects the cost of production. Thus, any changes in the exchange rate, either fluctuation or misalignment, will affect the economy's price level. Depreciation raises the prices of imported raw materials or intermediate products, resulting in higher production costs and less supply of locally created finished goods, thus putting pressure on the prices of domestic goods. In an open economy, changes in exchange rates influence the prices of local and imported goods and affect both domestic & global demand for domestic products.

***Demand-pull*** inflation is based on the economic principle that whenever there is excess aggregate demand, prices will increase. Thus, a higher exchange rate (measured as US$/PKR) implying depreciation reduces the value of a domestic currency with respect to foreign currency, making locally created finished goods more appealing to both domestic customers and foreigners while discouraging imports. Higher net exports lead to enhancing aggregate demand. Further, increased demand for locally created finished goods results in higher domestic prices of goods and services (Dornbusch et al., 1976). It is also mentionable that higher exchange rates lead to larger liabilities denominated in foreign currency and, as a result, lower net worth if assets are denominated in domestic currency. This restricts domestic enterprises' borrowing ability and reduces investment, placing pressure on goods prices to rise. One other important in this context is global interest rates, which directly impact local demand created through exchange rates.

In the literature, the central bank implements monetary policy to achieve macroeconomic management objectives, especially price stability, i.e., *controlling Inflation*. The transmission mechanism of the monetary policy refers to the process by which changes in the stance of monetary policy affect aggregate demand and Inflation. The exchange rate channel is considered an important channel through which monetary policy is transmitted. The reason being domestic and international economies are linked. For example, when domestic interest rates rise, local currency financial assets such as rupee-denominated bonds and deposits become more appealing. Increased demand for the local currency may increase its value or decrease the pressure on it to devalue. As the value of the domestic currency rises, the prices of domestic goods rise relative to the price of foreign goods, reducing net exports and, therefore, aggregate demand.

Pakistan is a developing economy and faced volatile inflation, throughout its history, due to certain domestic and international factors. It has been observed that when the

exchange rate remains overvalued, it results in higher imports of both consumption and capital goods. Further, capital goods have a significant share of imports, which intensified import bills, thus creating macroeconomic imbalances, especially in the external sector. Moreover, in Pakistan, where the tax-to-GDP ratio is low, overvalued exchange rate increases government expenditure through high government consumption and development expenditures. Thus, the fiscal deficit widened. In the past, budget deficits were substantially financed by money creation, primarily by increasing Central Bank credit to the Government. This led to excessive money creation, thus increasing aggregate demand through higher income. The exchange rate is the relative price of money, therefore, depreciated, creating Inflation. SBP thus has to raise the interest rate to curtail inflationary pressure, as Inflation control is the objective of SBP. Historically, it has also been observed that any measure is taken to align the exchange rate results in overshooting of the exchange rate, at least in the short run. Malik (2007) found that misalignments of exchange rates affect the foreign and domestic sectors, which affect the commodity prices in the economy. Thus, hurting Inflation significantly. One other adverse impact of misalignments of exchange rates occurred through competitiveness.

Miyamoto. et al. (2016) found that the real exchange rate appreciates in response to a positive government expenditure shock, and the effect is considerable up to a two-year horizon. The real currency rate gains by more than 3 percent on impact and up to 5 percent two years after a 1 percent rise in government spending as a percentage of GDP. The impact is greatest in countries where the currency value can rise and fall freely. Increases in government spending were found to have a significant negative impact on the current account, correlating with the findings of Monacelli and Perotti (2010). In addition, the impacts of government expenditure on the real exchange rate and consumption vary considerably across developed and developing nations. In developed nations, the actual

exchange rate depreciates by 3 percent, whereas it appreciates by more than 4 percent in emerging nations. In developing nations, government expenditure boosts consumption, but in affluent nations, government spending has a negative and statistically negligible effect on consumption. Both groups' current accounts decline.

It is mentionable that the exchange rate (fluctuations and misalignments) impacts foreign reserves and terms of trade which affect Inflation. Pakistan's monetary policy goal to include exchange-rate stability in the objective function is at the heart of its efforts to stabilize inflation. The argument is that changes in foreign exchange reserves will affect inflation (Lin, 2009). When interest rates on foreign exchange reserves are low, increasing foreign reserves results in a permanent decline in consumption (Fukuda and Kon 2010). It is argued that foreign exchange reserves have a long-run relationship with the broad money supply. Thus, the relationship between Inflation and exchange rates has always attracted economists to investigate. Exchange rate-inflation interactions are critical, particularly in emerging economies. Exchange rate fluctuations can substantially impact the general pricing level in these economies (Dornbuch, 1976).

It is also mentionable that in Pakistan, the major share in imports is the petroleum group. Thus, any change in international oil prices can impact inflation from both the demand and supply sides of the economy. Further, sometimes, it also happens that government is unable to transfer oil price increases to the consumer by subsidizing domestic prices. This, in turn, affects both government revenues due to less collection or petroleum levies and government expenditures due to an increase in subsidy amount. Historically, it has been observed that government revenues remained significantly less than expenditures which in turn ballooned the fiscal deficit. The fiscal deficit financed by money creation expanded expands the domestic money supply, which accelerated inflation. Further, in countries like Pakistan, borrowing for fiscal deficit also impact economic activity through crowding out as

Banks are willing to invest in government T-bills instead of giving loan for private investment. Thus, the fiscal deficit is also considered an essential intervening variable when analyzing the impact of the exchange rate on the price level.

Firstly, because higher inflation rates result in higher nominal mortgage interest rates, it increases in value and stimulates even more housing investment than is prudent. As a second point, "shoe-leather costs" are connected to keeping cash on hand. The constant decline in purchasing power of money and interest-free checking accounts is a major drawback of Inflation. People will spend significant economic resources (such as their time and "shoe leather") to save money on such money balances. In addition, high Inflation is frequently coupled with high exchange rate volatility, making individuals anxious about future inflation levels due to changes in the exchange rate. Therefore, uncertainty is also an essential variable in the analysis of exchange rates and Inflation.

### 6.3 Econometric Methodology

It is necessary to check the stationarity of the variables before undertaking a cointegration analysis (Kazi, 2008). The presence of a characteristic root equal to one is defined as a unit root. The variables used in the analysis were found to be a mix of stationary and nonstationary factors (results are presented in Appendix D). Therefore, the ARDL model is applied for estimation.

The ARDL model provides a robust framework for analyzing time series data and resolving many of the difficulties associated with other time series models. By incorporating both stationary and non-stationary variables, testing for the existence of a long-run relationship, and allowing for the estimation of short- and long-run effects, the ARDL model provides a powerful tool for econometric analysis.

Another point to consider is the order of integration. If the goal of the study is to establish a long-run level relationship and the sequence of integration of variables is unknown, the ARDL model provides a good technique to find cointegration among variables and estimate legitimate long-run relationships.

The ARDL model is used in this study to assess the impact of exchange rates on prices in order to develop short-run and long-run relationships. At the same time, the combination of misalignment and fluctuations is used by making four cases. Six models were estimated in this analysis as we move generally to a specific approach, as done in the previous chapter on economic activity. Therefore, in **Model 1,** the real effective exchange rate (REER) is used independent variable. Then, REER is replaced with misalignments which were estimated by a simple regression framework and ARDL. Thus, **Model-2** was estimated using misalignments estimated by the simple regression framework, and **Model-3** was estimated using ARDL misalignments. In the nonlinear model of REER in **Model-4**, Negative and positive changes in REER were used as independent variables. Lastly, our main concern models are **Model-5**, and **Model-6,** which used four combinations of appreciation and depreciation with overvalued and undervalued exchange rates. The main difference between **Model-5** and **Model-6** is that in **Model-5**, the misalignment of the exchange rate is estimated using a simple regression framework, whereas, in **Model-6**, it is estimated using the ARDL model (see Chapter 4 for more details). In all models, interest rate, income, money supply, oil prices, fiscal deficit, and exchange rate volatility (uncertainty) are used as explanatory variables. Akaike information criterion (AIC) and Schwarz information criterion (SIC) are also used for model selection in both linear and nonlinear models. Typically, the better the model's fit is, the smaller the AIC and SIC values.

**Linear Models**

**MODEL 1**

The objective is to analyze the effect of the exchange rate on the price level, so **Model-1** is estimated by using inflation as the response variable and real effective exchange rate (REER) as one of the explanatory variables, along with other explanatory variables. The data and variables section discusses the reason and definitions of all variables. To capture the exchange rate's short-run and long-run impact, the models used in estimation are as follows:

$$\Delta INFL_t = \eta_0 + \sum_{j=1}^{P} \eta_{1i} \Delta INFL_{(t-j)} + \sum_{i=0}^{q} \eta_{1i} \Delta \ln \text{LGDP}_{(t-i)} + \sum_{i=0}^{q} \eta_{2i} \Delta(\text{VOLI})_{(t-i)} + \sum_{i=0}^{q} \eta_{3i} \Delta(\text{CMR})_{(t-i)} + \sum_{i=0}^{q} \eta_{4i} \Delta(\text{REER})_{(t-i)}$$

$$+ \sum_{i=0}^{q} \eta_{5i} \Delta(\text{LOIP})_{(t-i)} + \sum_{i=0}^{q} \eta_{6i} \Delta(\text{LM 2})_{(t-i)} + \sum_{i=0}^{q} \eta_{7i} \Delta(\text{FD})_{(t-i)} + \lambda_1 \ln \text{LGDP}_t + \lambda_2 (\text{CMR})_t + \lambda_3 (\text{VOLI})_t$$

$$+ \lambda_4 (\text{REER})_t + \lambda_5 (\text{LOIP})_t + \lambda_6 (\text{L M 2})_t + \lambda_7 (\text{FD})_t + \mu_t \quad \text{.....(6.1)}$$

Infl stands for inflation, LGDP is used as a proxy for income, voli stands for exchange rate volatility, measured by GARCH, CMR stands for interest rate, REER stands for the log of real effective exchange rate, and loilp stands for oil prices. LM2 stands for the trade money supply, and FD stands for fiscal deficit. It represents long-run coefficients, whereas differenced variables represent short-run coefficients.

**MODEL 2 AND MODEL 3**

**Model-2** differs slightly from **Model-1**. The Misalignment of the exchange rate is replaced by REER in this model, while the response variable is the same as in **Model-1**. A simple regression framework was used to estimate Misalignment in **Model-2**. The calculation of Misalignment is explained in Chapter 4, which was used. The equation is as follows:

$$\Delta INFL_t = \eta_0 + \sum_{j=1}^{p} \eta_{1i} \Delta \text{lNFL}_{(t-j)} + \sum_{i=0}^{q} \eta_{2i} \Delta \ln \text{LGDP}_{(t-i)} + \sum_{i=0}^{q} \eta_{3i} \Delta(\text{VOLI})_{(t-i)} + \sum_{i=0}^{q} \eta_{4i} \Delta(\text{CMR})_{(t-i)}$$

$$+ \sum_{i=0}^{q} \eta_{5i} \Delta(\text{MISREER})_{(t-i)} + \sum_{i=0}^{q} \eta_{6i} \Delta(\text{LOIP})_{(t-i)} + \sum_{i=0}^{q} \eta_{7i} \Delta(\text{LM2})_{(t-i)} + \sum_{i=0}^{q} \eta_{8i} \Delta(\text{FD})_{(t-i)} + \lambda_1 \ln \text{LGDP}_t$$

$$+ \lambda_2 (\text{CMR})_t + \lambda_3 (\text{VOLI})_t + \lambda_4 (\text{MISREER})_t + \lambda_5 (\text{LOIP})_t + \lambda_6 (\text{L M2})_t + \lambda_7 (\text{FD})_t + \mu_t \quad \text{.....(6.2)}$$

The coefficients in the short run are represented as differenced variables, while those, in the long run, are represented by λ. Real exchange rates and misalignments of the exchange rate are explanatory factors, and inflation is the response variable in these equations.

**Test of Nonlinearity**

Before moving to the non-linear models, the linearity test is used to confirm the nonlinearity. In this sense, the CUSUM statistic test and the McLeod and Li (1983) test serve as the foundation for a formal linearity hypothesis test. In contrast to the alternative hypothesis, which contends that the relationship is not linear, the null hypothesis states that the relationship is linear. As discussed, this detail is already given in the previous Chapter 5 chapter.

**Nonlinear Models**

**MODEL 4**

Shin et al. (2014) showed that NARDL captures asymmetric interactions with long-term co-integration. ARDL decomposition of exchange rates as REER_POS and REER_NEG whereas REER_POS indicates real appreciation, and REER_NEG indicates real depreciation as discussed in Chapter 5. The equation is as fellows

$$\Delta INFL_t = \eta_0 + \sum_{j=1}^{p} \eta_{1i} \Delta \,\mathrm{lNFL}_{(t-j)} + \sum_{i=0}^{q} \eta_{2i} \Delta \,\mathrm{lnLGDP}_{(t-i)} + + \sum_{i=0}^{q} \eta_{3i} \Delta(\mathrm{CMR})_{(t-i)} + \sum_{i=0}^{q} \eta_{4i} \Delta(\mathrm{REER}-\mathrm{POS})_{(t-i)} + \sum_{i=0}^{q} \eta_{5i} \Delta(\mathrm{REER}-NEG)_{(t-i)}$$

$$+ \sum_{i=0}^{q} \eta_{6i} \Delta(\mathrm{LOIP})_{(t-i)} + \sum_{i=0}^{q} \eta_{7i} \Delta(\mathrm{LM\,2})_{(t-i)} + \sum_{i=0}^{q} \eta_{8i} \Delta(\mathrm{FD})_{(t-i)} + \sum_{i=1}^{q} \eta_{9i} \Delta(\mathrm{VOLI})_{(t-i)} + \lambda_1 \,\mathrm{lnLGDP}_t + \lambda_2 (\mathrm{CMR})_t$$

$$+ \lambda_3 (\mathrm{VOLI})_t + \lambda_4 (\mathrm{REER}-\mathrm{POS})_t + \lambda_5 (\mathrm{REER}-NEG)_t + \lambda_6 (\mathrm{LOIP})_t + \lambda_7 (\mathrm{LM\,2})_t + \lambda_8 (\mathrm{FD})_t + \varepsilon_t \ldots\ldots (6.3)$$

**MODEL 5 and 6**

The four cases discussed in Chapters 4 and 5 are used to capture the impact of combing exchange rate misalignment and fluctuation along with the volatility of exchange rate and other explanatory variables.

$$\Delta INFL_t = \eta_0 + \sum_{j=1}^{p} \eta_{1j} \Delta INFL_{(t-j)} + \sum_{i=0}^{q} \eta_{2i} \Delta \ln LGDP_{(t-i)} + \sum_{i=0}^{q} \eta_{3i} \Delta(VOLI)_{(t-i)} + \sum_{i=0}^{q} \eta_{4i} \Delta(CMR)_{(t-i)} + \sum_{i=0}^{q} \eta_{5i} \Delta(POS\_OVER)_{(t-i)}$$

$$+ \sum_{i=0}^{q} \eta_{6i} \Delta(NEG\_OVER)_{(t-i)} + \sum_{i=0}^{q} \eta_{7i} \Delta(POS\_UNDER)_{(t-i)} + \sum_{i=0}^{q} \eta_{8i} \Delta(NEG\_UNER)_{(t-i)} + \sum_{i=0}^{q} \eta_{9i} \Delta(LOIP)_{(t-i)} + \sum_{i=0}^{q} \eta_{10i} \Delta(LM2)_{(t-i)} +$$

$$+ \sum_{i=0}^{q} \eta_{11i} \Delta(FD)_{(t-i)} + + \lambda_1 LGDP_t + \lambda_2 (CMR)_t + \lambda_3 (VOLI)_t + \lambda_4 (POS\_OVER)_t + \lambda_5 (NEG\_OVER)_t + \lambda_6 (POS\_UNDER)_t + \lambda_7 (NEG\_UNER)_t$$

$$+ \lambda_8 (LOIP)_t + \lambda_9 (FD)_t + \lambda_{10} (LM2)_t + \mu_t \quad .....(6.4)$$

**Model-4** indicates that although we made the model nonlinear by combining misalignments and fluctuations, this was done on explanatory variables, which in turn resulted in finding an impact on prices at the aggregate level.

**Bound Test:**

The errors of the ARDL equation must be serially independent for testing long-run relationships (Pesaran et al., 2001). we perform an "F-test" known as a bound test. The critical values with lower and upper bounds of the F-statistics follow the asymptotic distribution. The lower bound in each case is based on the assumption that all variables are I(0), and the upper bound is based on assuming all variables are I(1) the detail bound test is discussed in previous chapter.

### 6.4 Definition and Construction of Variables and Data Span

In order to discuss the achieve the desired objectives of the research, CPI is used as the response variable, whereas misalignment and constructed four cases are used as explanatory variables; interest rate (CMR), 'income (LGDP), money supply (LM2), oil prices(oilp), fiscal deficit (FD), volatility of the exchange rate, and the log of real effective exchange rate is taken as other explanatory variables. The monthly data set for all variables has been used for the analysis in this study which ranges from Jan 1980 to Dec 2020. As discussed earlier, through the use of the linear, Litterman, and Chow-Lin approaches, we

were able to transform the low-frequency (annual or quarterly) variables into more high-frequency (monthly) data.

### 6.4.1 Prices

General CPI is used for measuring inflation. Further, the splicing method is used to convert the base year of 2007-08 = 100 into the base year 2009-10 = 100. By this, all variables were harmonized into the same base year of 2009-10.

### 6.4.2 Income

Real GDP has been used as a proxy of income which is GDP at constant basic prices. Further, as mentioned in the previous chapter, GDP data is available on annual frequency. But in Pakistan, quarterly GDP has been estimated by several studies Kemal & Arby (2004), Arby (2008). These studies estimate National Accounts expenditures quarterly. By applying the method, annual GDP was converted to quarterly while monthly GDP was calculated by using the Linear approach as given in EViews.

### 6.4.3 Interest rate

The call money rate (CMR) is used as a proxy for the interest rate in this research.

### 6.4.4 Oil Prices

For the oil price variable, we used the international price of crude oil. As crude oil has a significant amount of share in import of Pakistan. Pakistan, import crude oil. The data is available monthly as $ per barrel, thus log of oil prices is used in this research.

### 6.4.5 Fiscal Deficit

The Ministry of Finance published fiscal operation data on a quarterly basis mentioning fiscal details both at the Federal and Provincial levels in which consolidated and federal budget deficit is given in Rs million. In this research, consolidated fiscal deficit has been used, and for convenience, the log is also taken. Further, in order to convert the quarterly values into monthly values, the Linear method was used.

### 6.4.6 Money Supply

Money Supply is provided weekly by SBP in the statistics on Monetary Aggregates as a stock and flow variable in a million rupees. Monthly data was added to M2 stock in Jan 1980 to generate monthly M2. Log M2 was used.

### 6.4.7 REER, Fluctuations, and Misalignments

REER, Fluctuations, and Misalignments are the same as discussed earlier in chapter 5. However, considering the significance of uncertainty, which is responded to by agents immediately, the volatility of REER was estimated by GARCH to capture the uncertainty (discussed earlier in chapter 4), which was then used in all models.

## 6.5 Results and Discussion

### Stationarity Test and Lag Length

### Unit Root Tests

It has been found that no variable is I (2), while all variables are at I (1) and I (0). As explained earlier, variables are integrated at various levels, and the Auto-Regressive distributed Lag (ARDL) model has been used for analyzing long- and short-run relationships. The unit root results are shown in Appendix D.

### Lag Length Criteria

The appropriate selection of lag length is a prerequisite for the analysis. Any incorrect selection of lags may hinder or overfit the model respectively (Stock and Watson, 2012). As in the ARDL model, the automatic selection of lags is allowed to estimate the model. We have used AIC criteria for the selection of lag in analysis.

Three linear models and three nonlinear models are used to capture the linear impacts of changes in the exchange rate on prices, along with other explanatory variables. The results of these models are discussed below.

### 6.5.1 Result of Bound Test

According to Pesaran et al. (2001), the bound test was used. The results of the ARDL bound test show that cointegration exists among the series. The outcomes are shown in Table 6.1. The bound test value is greater than the lower bound and upper bound, mostly at the 1% significance level, indicating a long-run relationship between variables.

**Table 6.1: Bound test**

| Test Statistic | | Value | Signif. | I (0) | I (1) |
|---|---|---|---|---|---|
| **Model 1** | **F-statistic** | 3.98 | 1% | 3.07 | 4.23 |
| **Model 2** | | 17.76 | 1% | 2.73 | 3.9 |
| **Model 3** | | 7.93 | 1% | 3.07 | 4.23 |
| **Model 4** | | 7.80 | 1% | 2.93 | 4.06 |
| **Model 5** | | 9.26 | 1% | 2.68 | 3.84 |
| **Model 6** | | 10.93 | 1% | 2.41 | 3.61 |

Source: Author Calculation

### 6.5.2 Long run Results

**Linear Models**

The long-run results of the linear model are placed below in Table 6.2:

**Table 6.2: Long Results (Linear Models)**

| | Model-1 | P-values | Model-2 | P-values | Model-3 | P-values. |
|---|---|---|---|---|---|---|
| REER | -0.627 | (0.003) | | | | |
| MISREER | | | -0.160 | (0.044) | -2.833 | (0.053) |
| VOLI | 0.027 | (0.087) | 0.038 | (0.077) | 0.028 | (0.004) |
| LM2 | 0.031 | (0.756) | 1.208 | (0.066) | 1.116 | (0.051) |
| FD | 0.001 | (0.000) | 0.001 | (0.000) | 0.001 | (0.000) |
| CMR | -0.018 | (0.000) | -0.020 | (0.001) | -0.018 | (0.001) |
| LGDP | 0.954 | (0.048) | 1.833 | (0.001) | 2.060 | (0.001) |
| LOILP | 0.211 | (0.000) | 0.180 | (0.000) | 0.175 | (0.000) |
| TREND | 0.242 | (0.007) | 0.350 | (0.892) | 0.009 | (0.001) |

Dependent Variable: INFL
Source: Author Calculation

In **Model-1**, estimated results show that there exists a significant negative relationship between exchange rate fluctuations and inflation. REER is used to capture exchange rate fluctuations. Thus, an increase in REER will cause domestic inflation to fall and vice versa. The reason is that a change in REER will affect the demand for foreign goods, and hence there will be a direct and indirect impact on the profitability of producers, which will change the supply of goods, thus causing an impact on inflation in the opposite direction. Similar

results were found by Campa and Goldberg (2005) that a fall in the exchange rate is reflected in high consumer costs, which means high inflation in the economy. In the case of Pakistan, Ehsan and Khan (2002) made an empirical analysis and found no association between rupee devaluations and inflation in Pakistan for the period 1982 to 2001. However, our results are supported by the results found by Ahmed and Ram (1991), Khan and Qassim (1996), and Ahmad and Ali (1999).

It is also mentionable that volatility(uncertainty) of the exchange rate was found positively affect inflation in all linear models. One of the reasons is that exchange rate instability reduces the outflow of export components, which convinces investors to hold their investments. The fact thus supports the conventional theory that volatility(uncertainty) in the exchange rate depresses investment and international trade, which in turn affects supply. This, in turn, adds up to building inflationary pressure. Furthermore, the volatility in exchange rates also has a positive impact on the liquidity conditions in the money market. Thus, investors are ready to move their money away from currency markets to money markets. This money market performance will then translate into domestic inflation.

It was found that there is a positive relationship between money supply and prices, according to economic theory. Like the research of Kemal (2006), which found that a rise in money supply over the long run resulted in a greater rate of inflation, this finding provides theoretical support to the notion that inflation is a monetary phenomenon and, by extension, to the quantity theory of money. Further, the positive link between money supply and inflation in Pakistan. It can be defended on the account that agents' expectations about prices are stable. Thus, an increase in money supply leads to an increase in aggregate demand through the income channel, leading to inflation in the domestic economy. It also depends on the fact that Pakistan's economy is mainly consumption-driven due to fewer opportunities for saving and a high dependency ratio.

It was found that there exists a significant positive relationship between fiscal deficits and inflation. It is due to the fact that an increase in fiscal deficit leads to an increase in government borrowing, thus affecting the money supply, interest rate, and exchange rate as well. A fiscal deficit happens when a government spends more than it receives. The government spends more than it earns in taxes and other sources over time. It will crowd out private borrowing, manipulate capital structures, and create inflation. In Pakistan, it has been observed higher fiscal deficit is followed by a higher trade deficit, thus affecting expectations about the exchange rate. As a short-run measure, it has been seen that exchange rate adjustment is made whenever it is required to correct the macroeconomic imbalance. Thus, a significant positive relationship between fiscal deficit and inflation is observed not only in this model but also in the other two models as well. (Hyder and Shah 2004, Ahmed et al; 2018, Chaudri et al., 2002).

The negative and significant relationship between interest rates and inflation. The State Bank of Pakistan announces monetary policy every quarter to adjust interest rates based on the prevailing economic situation and expectations about inflation. If there is excess aggregate demand as well as there exist expectations of high inflation, SBP raises interest rates to curtail inflation by containing aggregate demand as well as reverting expectations of agents about inflation. Further, the interest rate can be considered as the cost of capital, which implies that an increase in interest rate will increase the cost of doing business, which impacts investment inversely. Moreover, lenders demand more due to a decrease in purchasing power parity.

It was also found in the study that income has a positive and significant relationship with inflation. Findings by Ahmad (2022) that moderate inflation is good for growth and trade, but that high inflation (in the double digits) is bad for Pakistan's economy are

supported by this correlation. It is reasonable to assume that a rise in income would cause a rise in demand and, consequently, pricing.

Regarding oil prices, it is found that oil prices and inflation have a positive relationship in the case of Pakistan, which is similar to Malik (2016) that oil prices have a crucial role behind inflation rates in Pakistan. The result of our study is supported by the fact that Pakistan is an oil-importing country, so an increase in oil prices internationally increases not only the import bill but also the cost of production as oil is used as input in production.

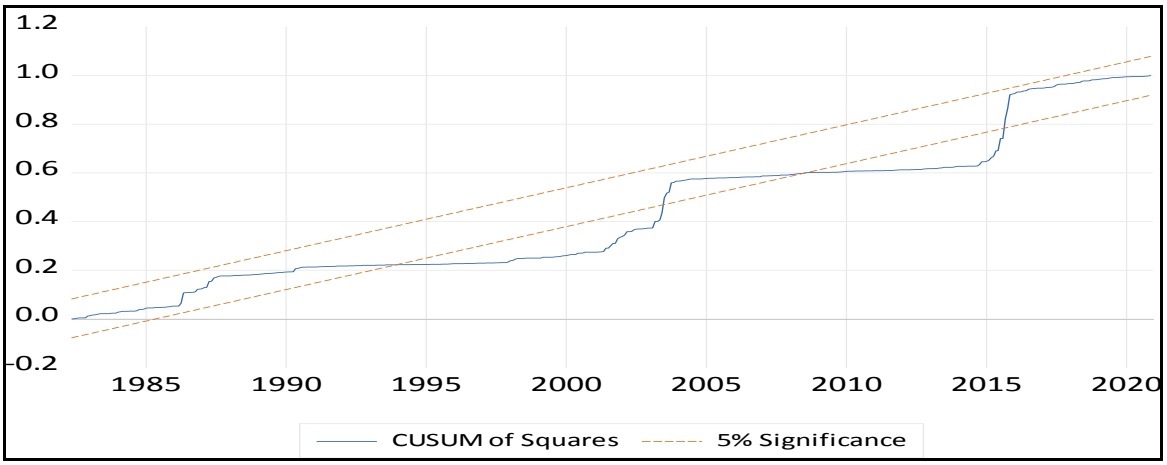
In **Model-2 and Model-3**, REER is replaced with misalignments. The difference between **Model-2 and Model-3** is that in **Model -2,** misalignment used is estimated with a simple regression framework, while in **Model-3,** misalignment is estimated by the ARDL model. It has been found that in both **Model-2** and **Model-3**, there is a significant negative relationship between misalignments of exchange rates and inflation. Generally, it is argued that inflation in Pakistan is also driven by agents' expectations. As a result, when the exchange rate is misaligned, the agents anticipate that the exchange rate will not remain the same and will depreciate significantly. Thus, aggregate demand starts falling, and inflation starts decreasing as well. According to Jaffri (2010), exchange rate pass-through has just a minimal impact on consumer pricing in Pakistan.

Regarding other explanatory variables, there is no difference in terms of impact and level of significance in **Model-2** and **Model-3.** However, there is a slight difference in the magnitudes of coefficients in **Model-3** compared to those estimated in **Model-2**. In all linear models, **Model-1**, **Model-2**, and **Model-3,** there exists a significant negative relationship between variation in the exchange rate and inflation, whereas variation is measured through either fluctuations or misalignment. The impact of other explanatory variables on inflation remains the same, with a slight difference in coefficient in all models.

**Structural Stability Test**

The stability of parameters is examined using the CUSUM and CUSUM square tests. The outcomes demonstrated that the model is unstable. The fig shows the CUSUM square test of model 1. The model is found to be nonlinear because the blue line shown in Fig. 6.1 does not fall inside the 5 percent significance threshold.

***Fig – 6.1: CUSUM square tests***




Source: Author's Estimation

## McLeod and Li (1983) test

The results of McLeod and Li (1983) test are given in ***Appendix E***. The Q statistics is significant, which shows that the model is a nonlinear model.

**Nonlinear Models**

In nonlinear **Model-4**, REER is decomposed into positive and negative variations. However, in **Model-5** and **Model-6**, fluctuations and misalignments are used simultaneously by constructing four different cases (discussed in detail in Chapter 4). The difference between **Model-5** and **Model-6** is that the misalignment used in the former is estimated by a simple regression framework, while the latter is estimated by the ARDL model.

In Nonlinear Models, prices are negatively linked with real depreciation (LREER_NEG) and positively linked with real appreciation (LREER_POS). Likewise, when a combination of

Fluctuations and Misalignment was used in making cases, it was found that Case-I (Overvaluation with appreciation) and Case-IV (Undervaluation with depreciation) are positively related to prices. In contrast, Case-II (Overvaluation with depreciation) and Case-III (Undervaluation with appreciation) are negatively related to prices. This supports our hypothesis that when Fluctuations and Misalignment are used individually, these give biased results and policy implications. The details of the long-run results of the Nonlinear model are placed below in Table 6.3:

**Table 6.3: Long run Results (Nonlinear Models)**

| | Model-4 | P VALUE | Model-5 | P VALUE. | Model-6 | PVALUE |
|---|---|---|---|---|---|---|
| **REER_POS** | 0.069 | (0.05) | | | | |
| **REER_NEG** | -0.754 | (0.00) | | | | |
| **APP_OVER** | | | 0.905 | (0.09) | 1.032 | (0.08) |
| **APP_UNDER** | | | -1.264 | (0.05) | -32.90 | (0.00) |
| **DEP_OVER** | | | -0.914 | (0.02) | -0.063 | (0.04) |
| **DEP_UNDER** | | | 0.306 | (0.04) | 1.468 | (0.00) |
| **VOLI** | 0.067 | (0.48) | 0.066 | (0.52) | 0.100 | (0.25) |
| **LM2** | 0.395 | (0.78) | 0.965 | (0.51) | 0.412 | (0.82) |
| **FD** | 0.002 | (0.00) | 0.002 | (0.00) | 0.002 | (0.00) |
| **CMR** | -0.017 | (0.00) | -0.010 | (0.04) | -0.006 | (0.03) |
| **LNGDP** | 1.527 | (0.03) | 1.863 | (0.01) | 3.327 | (0.00) |
| **LOILP** | 0.231 | (0.00) | 0.066 | (0.02) | 0.089 | (0.03) |
| **TREND** | 0.319 | (0.05) | 0.013 | (0.02) | 0.033 | (0.00) |

Dependent Variable: INFL

Source: Author Calculation

In Model-4, the decomposition of REER into positive and negative variations allowed us to analyze the impact of positive and negative values of REER on the price level. A significant positive relationship is found between appreciation and prices. The reason is that appreciation leads to imported goods becoming expensive, which leads to local prices. The depreciation is negatively related to prices as depreciation leads to cheaper imports, eventually lowering the economy's inflation. The reason could be that depreciation results in relatively cheap imports, while the governments may have implemented exchange rate

policies to control inflation. Nevertheless, even if imports comprise a sizeable share of the "basket" of living expenses, as is the case in Pakistan, their impact on measured inflation is negative as goods become cheaper, leading to lower price levels. The decomposition of REER means using the nonlinear Model has given different estimates, which support our claim that the linear model usually provides a biased result.

On the basis of results estimated in Model-5 and Model-6, it was found that Case I, Appreciation with the overvalued exchange rate, positively affects the prices. The reason is that we maintain an overvalued exchange rate when our economy is stable. In that condition, the exchange rate positively changes, meaning further appreciation of the exchange rate. This will increase demand, and thus prices will increase in the economy. Consequently, the appreciation in REER, even overvalued, will raise domestic inflation as demand for imported goods increases. Further, on the basis of Waqas et al. (2013) results, internal terms of trade become unfavorable as the demand for domestically produced goods decreases significantly if the exchange rate is overvalued. Case II depreciation and overvalued mean that initially when the exchange rate is overvalued, the stability is there, but now the condition change and reserves are depleted, and the exchange rate becomes depreciated and negatively affects the economy and prices. The reason could be that an already overvalued exchange rate and further depreciation exchange rate increase domestic demand and decrease foreign demand, negatively impacting inflation. Case III appreciation and undervalued are significantly less period and its convergent case negative effect, and the results are significant.

Case IV deprecation with undervalued is simple. Undervalued with depreciation exchange rate had a positive impact due to increased demand for domestic goods. According to theory, the currency is undervalued, and further depreciation leads to undervalued than its positive impact on prices. The literature has offered several explanations for the link between undervalued currencies and inflation. According to Rodrik (2008), undervaluation promotes

growth by expanding the tradable sector. Such a growth-enhancing effect causes the economy to overheat (Haddad & Pancaro, 2010; Grekou, 2018), resulting in inflationary pressures. Furthermore, real exchange rate undervaluation has an impact on the business environment. Indeed, real undervaluation increases the cost of importing inputs and machinery (Chen, 2017), raising the costs of businesses and resulting in a cost-push inflation phenomenon.

Thus, the results of both Model-5 and Model-6 are almost similar, but the magnitude of the coefficient is higher in Model-6 compared to that in Model-5, except for the Money supply. Thus, the overall magnitude remained high in case of misalignment estimated by ARDL. The reason is that in the ARDL methodology, the misalignment capture is also divided into short and long runs to avoid bias, so the results show more impact of each case. Further, inflation in Pakistan is influenced by domestic factors such as market imperfections. As a result, domestic goods prices play a more significant role than wages as downward nominal wage rigidity in Pakistan. Waqas. et al., (2013).

It is also mentionable that the estimated results of Models 4, 5, and 6 show that explanatory variables other than REER have similar effects in terms of relationship and level of significance. Further, the uncertainty positively affects the prices as an increase in uncertainty increases individuals' expectation of further uncertainty in the markets, increasing the prices in the economy. Regarding Money Supply growth, it is found that there is a significant positive relationship with prices following the theory as explained in the linear Model. In these models, it was also found that income is positively linked with prices, and interest rate is negatively related to prices. However, the fiscal deficit was found to be significantly positive in a nonlinear model, even similar in magnitude estimated by a linear model.

In all three nonlinear models, long-run results showed that oil prices were positive and significantly affecting prices which implies that an increase in oil prices will raise domestic

inflation, which is valid on account that there is a pass-through impact of change in oil prices. The reason is that oil is used as input in many commodities directly and indirectly. A further change in oil prices can impact transportation costs.

### 6.5.3 Short run Results

The estimation of the ARDL model gives us both short-run and long-run results. As per ARDL methodology, the short-run results are placed below in Table 6.4. It has been found that the lags and growth rate of the response variable is significant and positive. It implies that any change that occurs in the last months will impact prices in the current month. It is concluded that inflation has a causal effect on itself over time. The reason is that an increase in inflation will affect the current inflation; the effect may be dampening over time, and the inertia effect increase in one period will continue to affect three months.

Like the relationship found in the long run, in the short run, REER is negative and significantly affects the prices in Model-1, while misalignment affects prices negatively in both Model-2 and Model-3. However, the coefficient found is insignificant in both Model-2 and Model-3.

Regarding other explanatory variables, In Model-1, the money supply in the short run positively affects the current prices. The reason is that an increase in money supply will increase aggregate demand, which in turn increases inflation. It was found that uncertainty and Fiscal deficit are positively impacting the prices. It was found that interest rate negatively affects income, and oil prices positively affect the prices in the short run. The positive relationship between income and prices can be related to expectations and uncertainty. If the prices are stable, it will lead to an increase in the motivation to invest, which leads to an increase in output. Eventually, it will lead to increased income and demand, and inflation will rise.

In both Model-2 and Model-3, the relationship of other explanatory variables with prices remained similar to those found in Model-1. Money supply in the short run positively affects the current prices. Likewise, uncertainty and fiscal deficit are positively impacting the prices. However, coefficients of fiscal deficit are a negligible impact in all three models. The reason may be that the change in fiscal deficit had no immediate consequences on prices. Likewise, interest rate negatively affects income, and oil prices positively affect the prices in the short run.

**Table – 6.4: Short run Results (Linear Models)**

| | Model-1 | | Model-2 | | Model-3 | |
|---|---|---|---|---|---|---|
| | **Coefficient** | **P-value.** | **Coefficient** | **P-value** | **Coefficient** | **P-value** |
| **REER** | -0.657 | 0.001 | | | | |
| **MISREER (-1)** | | | -0.165 | 0.406 | -2.729 | 0.156 |
| **LM2** | 0.125 | 0.933 | 1.248 | 0.393 | 1.075 | 0.459 |
| **VOLI** | 0.029 | 0.035 | 0.039 | 0.047 | 0.027 | 0.051 |
| **CMR** | -0.018 | 0.005 | -0.020 | 0.003 | -0.018 | 0.008 |
| **INFL (-1)** | -1.048 | 0.000 | -1.033 | 0.000 | -0.963 | 0.000 |
| **FD (-1)** | 0.002 | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 |
| **LNGDP (-1)** | 0.999 | 0.104 | 1.894 | 0.001 | 1.985 | 0.000 |
| **LOILP (-1)** | 0.221 | 0.000 | 0.186 | 0.000 | 0.169 | 0.001 |
| **D(FD)** | 0.000 | 0.982 | 0.001 | 0.847 | 0.001 | 0.757 |
| **D (FD (-1))** | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 |
| **D (FD (-2))** | 0.001 | 0.013 | 0.000 | 0.042 | 0.000 | 0.058 |
| **D(LNGDP)** | 10.378 | 0.003 | 10.039 | 0.005 | 7.675 | 0.033 |
| **D (LNGDP (-1))** | -2.159 | 0.542 | -3.048 | 0.394 | -2.259 | 0.530 |
| **D (LNGDP (-2))** | 17.320 | 0.000 | 16.380 | 0.000 | 16.415 | 0.000 |
| **D(LOILP)** | 1.112 | 0.000 | 1.141 | 0.000 | 1.187 | 0.000 |
| **D(MISREER)** | | | | | -0.585 | 0.611 |
| **D (MISREER (-1))** | | | | | 2.733 | 0.015 |
| **INFL (-2)** | | | | | -0.054 | 0.394 |
| **INFL (-3)** | | | | | -0.122 | 0.009 |
| **C** | -12.198 | 0.248 | -31.317 | 0.001 | -32.255 | 0.000 |
| **TREND** | 0.006 | 0.030 | 0.009 | 0.001 | 0.009 | 0.000 |
| **ECM** | -1.079 | 0.000 | -0.963 | 0.000 | -0.078 | 0.000 |
| **Durbin-Watson** | 1.96 | | 1.99 | | 1.99 | |
| **AIC** | 0.866 | | 0.854 | | 0.843 | |
| **SBC** | 1.159 | | 1.130 | | 1.128 | |

Dependent Variable: INFL
Source: Author's Estimation

The value of ECM disequilibrium at a monthly rate of approximately 9%, 7%, and 7%, respectively, to reach the steady-state or long-run equilibrium, implying that deviations from long-run equilibrium are rectified in the short run and will take nearly one year to adjust. Finally, the Durbin-Watson statistic results are 1.99, which is nearly equal to 2 in all linear models, indicating that there is no autocorrelation in the model. On the basis of both the Akaike information criterion (AIC) and Schwarz Information criterion (SIC), **Model-3** seems the better fit if we compare model 2 and model 3.

**b) Nonlinear Short run Results**

In nonlinear models, even in the case of the short run, the same relationship holds between variables of interest as found in the long run. **Model-4** finds that real depreciation is negative while real appreciation is positively affecting the prices. Whereas Results of **Model-5** and **Model-6** revealed that convergent cases of exchange rate changes have a negative impact on inflation, whether divergent cases positively affect the prices.

Regarding other explanatory variables, the relationship between money supply and prices is found to be positive in the short run. However, its coefficient remains insignificant. Depending on the elasticity of the short-run aggregative supply curve, an increase in money supply is divided into a rise in price level and a rise in real income (Ahuja, 2017).

Volatility was found to positively affect prices in the short run in all nonlinear models. Thus, it can be argued that uncertainty positively affects the economy. Contracts of export depend on exchange rate uncertainties, so it affects inflation.

The fiscal deficit has an almost negligible impact on prices, but the results were significant in all models. Montiel (1989) and Dornbusch, Sturzenegger, and Wolf (1990) found that fiscal deficits tend to accumulate rather than drive inflation –instead, they relate mainly to a combination of exchange rate and inflationary inertia. In this research, no significant relationship between fiscal deficit and inflation may be because most of the time,

the fiscal deficit was financed by government borrowing from SBP, which raised NDA and thus money supply. However, whenever the government signed an IMF program, as happened more recently (2019), IMF restricted the government from borrowing from SBP. However, the government can borrow from commercial banks. Thus, there is a possibility that the impact on prices has been biased toward the money supply.

It was also found that the coefficient of interest rate, income, and oil prices remained positive in all models, while the interest rate was insignificant. Oil price increases resulted in higher price levels in the economy. Hence its impact is positive and significant. The reason is that the increase in oil prices leads to an increase in the cost of production, which in turn leads to an increase in the price level. But it is mentionable that there is a difference in its magnitude in all models. Oil is a necessary input in all economic activities. A further rise in oil prices also leads to an increase in transportation costs. So, producers respond quickly to an increase in oil prices which raises inflation in the economy and leads to high prices. However, the phenomena may not be as responsive in the case of a decrease in oil prices. (Producer's behavior to respond to prices is downward rigid) Asghar and Naveed (2015) looked into the impact of global oil price fluctuations on Pakistan's inflation rate. Their findings backed up the idea that price changes in petroleum products substantially impacted overall costs in Pakistan. Eatzaz and Saima (1999) found that exchange rate depreciation leads to an increase in the import price level will increase inflation. Similar results were found by Ahmad and Ali (1999) that import prices are fully reflected in exchange rates and affect inflation. Import costs rise due to a devalued currency, which feeds domestic inflation (Kandil, Morsy, 2011).

Income is positively linked with inflation, and the reason is that increase in income leads to an increase in demand for goods which eventually leads to an increase in prices, as the conventional theory of economies predicts.

**Table 6.5 Short Run Results (Nonlinear Models)**

| | Model-4 | | Model-5 | | Model-6 | |
|---|---|---|---|---|---|---|
| | **Coefficient** | **P value** | **Coefficient** | **P value** | **Coefficient** | **P value** |
| **REER_POS** | 0.074 | 0.888 | | | | |
| **REER_NEG** | -0.024 | 0.067 | | | | |
| **POS_OVERVAL** | | | 0.305 | 0.080 | 0.058 | 0.000 |
| **NEG_OVERVAL** | | | -0.206 | 0.010 | -0.743 | 0.000 |
| **POS_UNDERVAL** | | | -1.305 | 0.180 | -1.058 | 0.000 |
| **NEG_UNDERVAL** | | | 0.316 | 0.380 | 1.743 | 0.000 |
| **LM2** | 0.427 | 0.079 | 0.997 | 0.053 | 0.489 | 0.019 |
| **VOLI** | 0.073 | 0.045 | -0.068 | 0.055 | 0.119 | 0.048 |
| **FD (-1)** | 0.002 | 0.000 | 0.002 | 0.000 | 0.002 | 0.000 |
| **CMR** | 0.019 | 0.205 | 0.010 | 0.121 | 0.007 | 0.318 |
| **LNGDP (-1)** | 1.651 | 0.030 | 1.924 | 0.012 | 3.950 | 0.000 |
| **LOILP (-1)** | 0.250 | 0.000 | 0.068 | 0.300 | 0.106 | 0.146 |
| **INFL (-1)** | -1.082 | 0.000 | -1.032 | 0.000 | -1.187 | 0.000 |
| **LREER_NEG (-1)** | -0.816 | 0.000 | | | | |
| **POS_OVERVAL (-1)** | | | -0.934 | 0.093 | 1.225 | 0.079 |
| **NEG_OVERVAL (-1)** | | | -0.944 | 0.021 | -0.075 | 0.984 |
| **INFL (-2)** | 0.047 | 0.549 | -0.017 | 0.783 | 0.156 | 0.076 |
| **INFL (-3)** | -0.041 | 0.530 | -0.110 | 0.016 | 0.010 | 0.888 |
| **INFL (-4)** | 0.065 | 0.155 | | | 0.108 | 0.022 |
| **D(FD)** | 0.000 | 0.441 | 0.000 | 0.249 | 0.000 | 0.323 |
| **D (FD (-1))** | -0.001 | 0.000 | -0.001 | 0.000 | -0.001 | 0.000 |
| **D (FD (-2))** | -0.001 | 0.006 | -0.001 | 0.000 | -0.001 | 0.000 |
| **D (FD (-3))** | -0.001 | 0.000 | -0.001 | 0.000 | -0.001 | 0.000 |
| **D(LGDP)** | 8.161 | 0.023 | 9.112 | 0.011 | 6.515 | 0.075 |
| **D (LGDP (-1))** | -0.946 | 0.792 | -0.053 | 0.988 | -1.787 | 0.637 |
| **D (LGDP (-2))** | 17.225 | 0.000 | 18.573 | 0.000 | 17.135 | 0.000 |
| **D(LOILP)** | 1.160 | 0.000 | 1.011 | 0.000 | 1.042 | 0.000 |
| **D(LM2)** | | | | | 13.133 | 0.045 |
| **D(LREER_NEG)** | -1.303 | 0.429 | | | | |
| **D (LREER_NEG (-1))** | 2.334 | 0.249 | | | | |
| **D (REER_NEG (-2))** | -3.908 | 0.016 | | | | |
| **D(POS_OVERVAL)** | | | 2.040 | 0.472 | | |
| **D (POS_OVERVAL (-1))** | | | 7.105 | 0.025 | | |
| **D(NEG_OVERVAL)** | | | -3.574 | 0.112 | | |
| **D (NEG_OVERVAL (-1))** | | | -1.526 | 0.580 | | |
| **D (NEG_OVERVAL (-2))** | | | -5.123 | 0.018 | | |
| **D(POS_UNDERVAL)** | | | | | -5.248 | 0.003 |
| **D (POS_UNDERVAL (-1))** | | | | | 1.762 | 0.422 |
| **D (POS_UNDERVAL (-2))** | | | | | -7.428 | 0.001 |
| **D (POS_UNDERVAL (-3))** | | | | | 1.851 | 0.097 |
| **D(NEG_UNDERVAL)** | | | | | -1.595 | 0.314 |
| **D (NEG_UNDERVAL (-1))** | | | | | 2.550 | 0.189 |
| **D (NEG_UNDERVAL (-2))** | | | | | 3.749 | 0.016 |
| **C** | -13.700 | 0.044 | -16.638 | 0.025 | -6.520 | 0.001 |
| **TREND** | 0.013 | 0.023 | 0.014 | 0.016 | 0.039 | 0.000 |
| **ECM** | -0.045 | 0.000 | -0.115 | 0.000 | -0.079 | 0.000 |
| **Durbin-Watson stat** | 1.99 | | 1.97 | | 1.98 | |
| **Akaike info criterion** | 0.847 | | 0.962 | | 0.937 | |
| **Schwarz criterion** | 1.184 | | 1.215 | | 1.143 | |

Dependent Variable: INFL
Source: Author's Estimation

**Model Selection**: On the basis of both the Akaike information criterion (AIC) and Schwarz Information criterion (SIC), **Model-6** seems the best fit. According to the ECM, the error, or

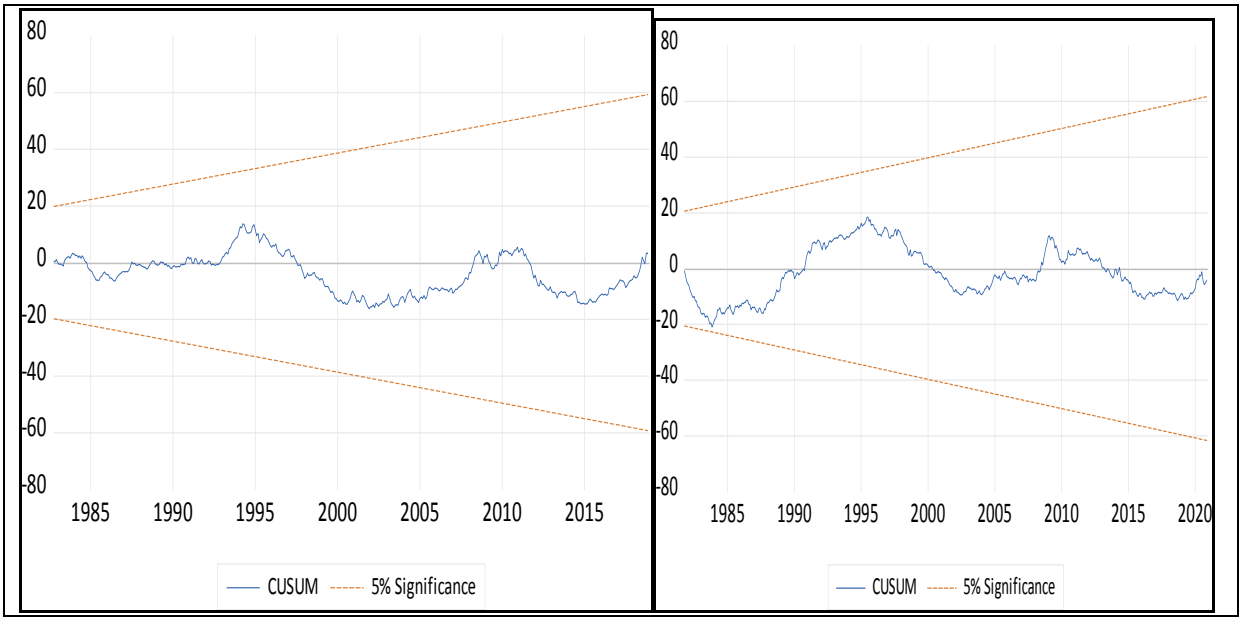
deviation from a long-run equilibrium, affects the short-run dynamics of a system. ECM estimates the rate at which a dependent variable returns to equilibrium directly. The coefficient must be significant and have a negative sign. A highly significant ECM coefficient, according to Banerjee et al. (1993) and Kinanemarim (2014), indicates the presence of a strong long-run connection. The coefficient of the error correction model is approximately −0.09, −0.08, and −0.07 in all models, indicating the speed of adjustment toward the equilibrium value, and it is statistically significant. The value of ECM is based on the error correction coefficient in the ECM model, and it can be stated that the system corrects its previous disequilibrium at a speed of approximately 9%, 8%, and 7%, respectively, on monthly bases to reach the steady-state or long-run equilibrium. Lastly, the results of the Durbin-Watson statistic are almost equal to 2 in all linear and nonlinear models, indicating no autocorrelation in the model.

### 6.5.4 Structural Stability Test

Brown et al. (1975) recommended that the CUSUM tests be used to determine the model's parameter stability and the correctness of the estimated models in the case of a simple regression framework. Fig – 6.2a The CUSUM test of linear model 2 and model 3 and Fig – 6.2b include the CUSUM test of linear model 4 and model 5 model 6 shows the CUSUM graphs for the ARDL models. According to the graph, under the null hypothesis of coefficient constancy, the values of the resultant sequence are within the 95 percent confidence interval, suggesting coefficient stability.

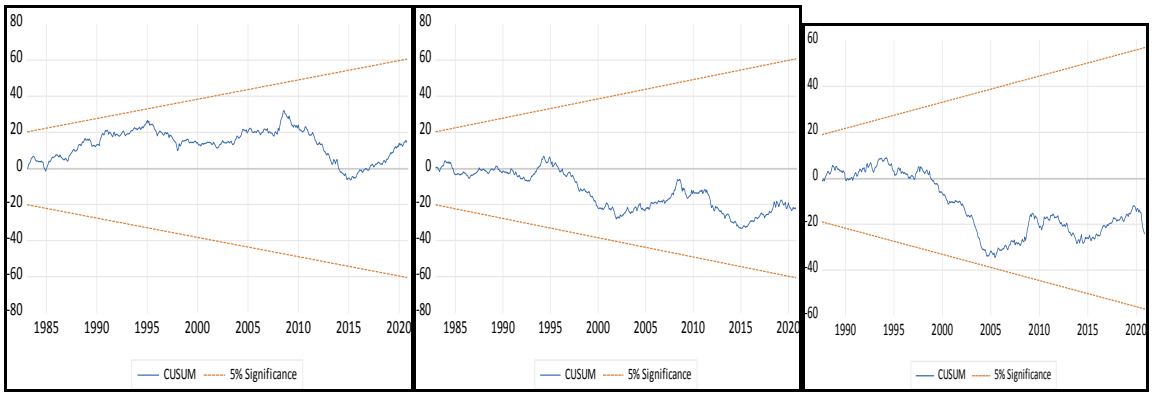
**Linear model**

***Fig - 6.2 a: CUSUM plot ARDL***




**Nonlinear model**

**Fig - 6.2 b: cusum of nonlinear ARDL**




## 6.6 Conclusion

In this chapter, the relationship between prices and variations in the exchange rate was explored. Six empirical models were estimated. Three of them were linear ARDL, while the other three were non-linear ARDL models. In all these models, income, money supply, interest rate, oil prices, fiscal deficit, exchange rate, misalignment, and combination of misalignment with fluctuation were used as explanatory variables. Considering linear models, in **Model-1**, fluctuations in exchange rates are used, but in **Model-2** and **Model-3**, REER is replaced with misalignments. In all linear models, these found a negative relationship between variation in the exchange rate and inflation, whether variation in the exchange rate is considered as fluctuations or misalignments in exchange rates. The study also found a

significant positive relationship between income and inflation. Increased income leads to higher demand, which raises prices, as per economic theory. In Pakistan, oil prices and inflation have a positive relationship, as the interest rate and inflation have a negative and significant relationship. It is also mentionable that volatility(uncertainty) of the exchange rate was found positively affect inflation in all models.

Considering non-linear models, in **Model-4,** the REER is disintegrated into positive and negative variations of the exchange rate (appreciation and depreciation). However, negative changes in REER have a significant and negative effect on prices, while positive changes in REER mean real appreciation positively and significantly impacts the prices. The nonlinear impact of the exchange rate on inflation using combinations of misalignments and fluctuations simultaneously by constructing four different cases estimated in **Model-5** and **Model-6.** The results showed that convergent cases (cases II and III) have a negative effect on the prices while divergent cases (cases I and IV) have a positive effect on prices. The estimated results found that there exists a positive impact of explanatory variables (income, oil prices, Money Supply, volatility, and Fiscal deficit) on prices. But interest rate was found negatively and significantly affect prices, which is according to fundamentals of economic theory.

# Chapter 7

## Conclusion and Policy Recommendations

Internationally, it has been discovered that a proper exchange rate policy is necessary for the country's long-term development, particularly when the country is experiencing macroeconomic imbalances. However, in literature, both misalignment and fluctuation of the two concepts were usually used interchangeably. Although, there is the possibility that sometimes fluctuations can lead to the correction of misalignments, which is different from fluctuations intensifying the misalignments. Thus, the impact of fluctuations in the exchange rate on macroeconomic variables is dependent on its movement with respect to the equilibrium exchange rate. Therefore, analyzing fluctuations or misalignment separately for the analysis may produce partial and unclear behavior of macroeconomic variables, leading to false policy implications. This study thus assessed the impact of the exchange rate on economic activity and prices by employing misalignments and fluctuations of the exchange rate simultaneously.

Thus, at the first step in this research, exchange rate misalignments were estimated by calculating the gap between actual REER and its equilibrium value. Therefore, two approaches were used to estimate the misalignments of the exchange rate. One was Purchasing Power Parity (PPP) approach, and the other was the Behavioral Equilibrium Exchange rate (BEER) approach. The BEER misalignments were estimated by a simple regression framework and by the ARDL model. Furthermore, the explanatory variables for estimating misalignments remained the same in all methods, which include interest rate differentials, Net Foreign Assets, government consumption, government investment expenditure, and Terms of trade.

Historically in the case of Pakistan, from 1947 to April 1972, the exchange rate was fixed at around 4.77 Rs per dollar, devalued to 11.00 Rs per dollar from May 1972 to Jan 1973, and 9.90 Rs per dollar till Dec 1980. Thus, a fixed exchange rate regime was followed in Pakistan till the 1980s. The economic condition, which started in an impressive way in the 1960s, became depressive till the 1980s due to geopolitical conflicts like the Indo-Pak war and uncertainty in domestic politics due to the switching of the regime from democratic to authoritarian. Further, Afghan War brought an influx of capital inflows in terms of aid/donations. Thus, the economic condition was able to bear the overvaluation of the exchange rate but to a certain time on account of the dynamics of the exports and import structure in Pakistan. The Pakistani rupee, thus, depreciated by 51 percent and stood at 20 on average till 1990. It is mentioned that after the Afghan War and the imposition of Pressler sanctions in October 1990, the significant level of foreign aid was cut off. Further, during the decade performance of macroeconomic variables remained highly volatile, with severe imbalances causing low growth and high inflationary pressures of that time, thus leading the exchange rate to depreciate by almost 63 percent reaching 51.7 Rs per dollar.

The period of 1999 to 2008 is considered the period of authoritarian again. However, the incidence of 9/11 spikes in foreign aid were recorded. Further, the economy also moved toward expansion with fewer macroeconomic imbalances and was more inclined toward services. All these factors contributed to minimum depreciation of 17 percent compared to what be seen previously. The exchange rate settled around 62.5 Rs against one dollar by the end of FY2008. With the start of a new political era, the depressed macroeconomic balances due to the foreign aid influx started mounting again. Thus, in Nov 2008, macroeconomic imbalances led Pakistan to seek assistance from the IMF, which at first depreciated currency by 20 percent, and the exchange rate was 78.5 Rs per dollar. After FY2009, the currency depreciated with an average of around 5 percent for this whole political regime, while the

exchange rate became 96.7 Rs against one dollar by the end of FY2013. Thus, the exchange rate remained misaligned from 2008 to 2013, while it remained undervalued till December 2019, but afterward, the exchange rate was considered overvalued till 2020. It is also mentionable that the government usually maintained overvalued exchange rates in order to build the confidence of the general public. Further, generally with the change of government, significant fluctuations in the exchange rate were found.

Fluctuations are classified into appreciation (if REER>0) and depreciation (if REER<0), while misalignments are classified as overvaluation (if mis>0) and undervaluation (if mis<0). This research thus combined misalignments (overvalued/undervalued) with fluctuations (appreciation/depreciation) by constructing four cases following the NARDL methodology.

Further, Cases I and IV are divergent cases; for example, Case I implies that the currency is currently overvalued (beyond the equilibrium level) but that further appreciation can push it further away from equilibrium. Case II and III, on the other hand, are convergent cases. As in Case II, the exchange rate is initially overvalued. However, depreciation led to the equilibrium level.

The research, thus, explored the relationship between economic activity and price level in Pakistan and a number of driving factors, with special emphasis on exchange rate misalignments, fluctuation, and uncertainty. In linear models, when fluctuations and misalignment are used separately, it was found that both negatively affect economic activity. In the nonlinear ARDL Model, appreciation has a negative effect on economic activity, whereas deprecation has a positive effect. When the combination of fluctuations and misaligns was used, it was found that convergent cases positively affect economic activity, whereas divergent cases negatively affect economic activity owing to internal and external imbalances. Other variables which were positively related to economic activity are inflation,

oil prices, openness, and uncertainty related to the exchange rate. But interest rate and uncertainty of exchange were found to be negatively related to economic activity in both linear and nonlinear models as both depress investment and hence economic activity. If the exchange rate is unstable, producers will invest less.

In the analysis of the price level with the exchange rate, the linear models suggest that both fluctuations and misalignments have a negative relationship with prices when both are used separately. But in NARDL Model, real appreciation has a positive influence on the price level, whereas real depreciation has a negative effect on prices. Incorporating both fluctuations and misalignments together reveals that convergent situations have a negative impact on pricing, while divergent cases have a positive impact on prices. Briefly, it is argued that the estimated results thus endorse the need to use a combination of misalignment and fluctuations for analyzing the impact of exchange rates on macroeconomic variables, especially economic activity, and prices.

### 7.1 Policy Recommendations

The findings of the study help us draw up some policy recommendations. This implies that depreciation or appreciation of the local currency is not always harmful. It all depends on how far the exchange rate is from its equilibrium value and in which direction the exchange rate is moving – i.e., towards equilibrium or away from equilibrium. So, there are cases in favor of and against central bank intervention. It should intervene directly in the foreign exchange market or indirectly through interest rate only if the exchange rate is away from its equilibrium or it is further diverging from equilibrium.

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**Appendix A**

UNIT ROOT TEST TABLE (PP)

| | At Level | | | | | | |
|---|---|---|---|---|---|---|---|
| | | LRER | LTOT | LNFA | GOVINES | GOVCON | IDIFF |
| With Constant | t-Statistic | -1.737 | -1.725 | -0.448 | -1.918 | -1.230 | -5.826 |
| | Prob. | 0.412 | 0.418 | 0.898 | 0.324 | 0.663 | 0.000 |
| | | n0 | n0 | n0 | n0 | n0 | *** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| With Constant & Trend | t-Statistic | -1.422 | -2.281 | -2.465 | -8.105 | -7.484 | -7.344 |
| | Prob. | 0.854 | 0.443 | 0.346 | 0.000 | 0.000 | 0.000 |
| | | n0 | n0 | n0 | *** | *** | *** |
| Without Constant & Trend | t-Statistic | -1.735 | -1.537 | 2.389 | 1.134 | 4.065 | -5.266 |
| | Prob. | 0.079 | 0.117 | 0.996 | 0.934 | 1.000 | 0.000 |
| | | * | n0 | n0 | n0 | n0 | *** |
| | At First Difference | | | | | | |
| | | d(LRER) | d(LTOT) | d(LNFA) | d(LDEV) | d(LCUR) | d(IDIFF2) |
| With Constant | t-Statistic | -16.302 | -8.846 | -21.740 | -19.893 | -13.241 | -59.415 |
| | Prob. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | *** | *** | *** | *** | *** | *** |
| With Constant & Trend | t-Statistic | -16.300 | -8.825 | -21.724 | -19.784 | -13.360 | -61.228 |
| | Prob. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | *** | *** | *** | *** | *** | *** |
| Without Constant & Trend | t-Statistic | -16.269 | -8.898 | -21.570 | -17.808 | -10.757 | -56.158 |
| | Prob. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | *** | *** | *** | *** | *** | *** |

**appendix B.**

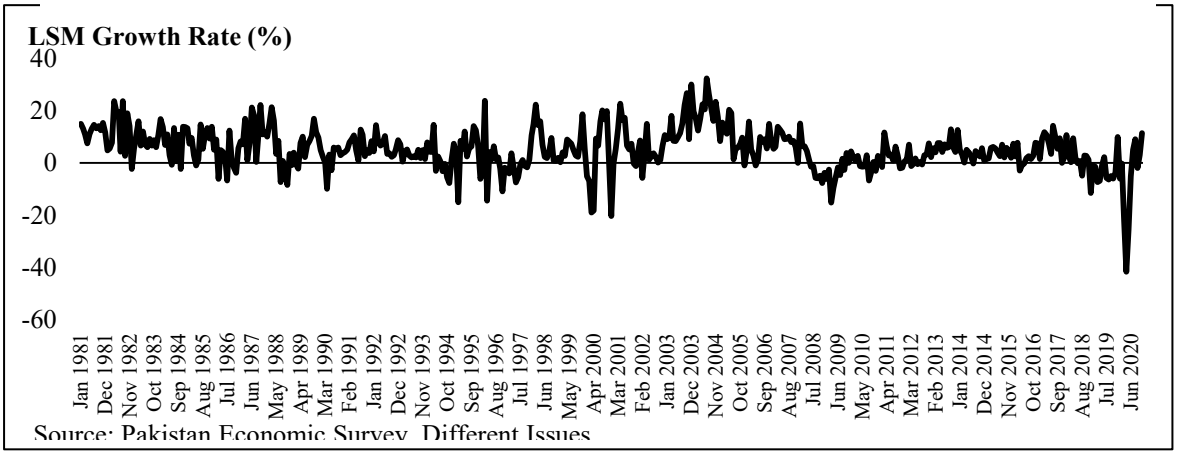
## Variables Descriptions and Construction

In order to discuss desired objectives of the research, the research is comprised of three analytical chapters. Depending on the requisite objective and the related hypothesis, different variables were used in the analysis. Thus, the following section gives a description of the variables.

**Description of variables**

**LSM**

For this research, Large-scale manufacturing (LSM) has been used as a proxy to determine economic activities. In Pakistan, LSM is the only major component of GDP on which data is available on a monthly basis, but with a lag of about two months from the end of the reference period. There is no published data on quarterly GDP while even annual GDP data is generally released with a considerable lag. Thus, policymakers and analysts keep track of a range of macroeconomic variables to make informed judgments about the future state of economic activities. The manufacturing sector of accounts for 13 percent of GDP while large scale manufacturing (LSM), accounts for approximately 760 percent of manufacturing and almost 10 percent of GDP. LSM showed growth of almost 7 present YoY during 1980. However, this



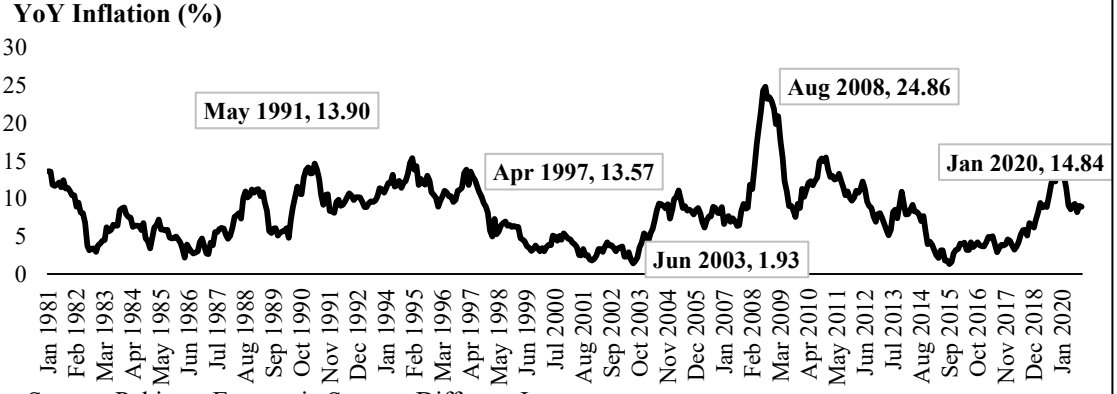
Source: Pakistan Economic Survey, Different Issues

sector experienced slowdowns in the 1990s to almost 3 percent. The performance of LSM is high volatile with an average YoY growth of 5.2 percent. Regarding LSM it is stated that in Pakistan, the LSM index is constructed by PBS which is derived from the Census of Manufacturing Industries (CMI) 2005-06 from which 112 items with total weights of 70.33 of value-added. Though the base year of LSM changed in different years this research has been harmonized on the recent base year 2005-06. Further, the LSM index is capturing the performance of industrial production having a (76.1%) share in manufacturing, (50.9%) in Industry and (9.7%) in GDP.

## Inflation

In Pakistan, CPI, WPI and GDP deflator are used to measure inflation. However, in this research, Consumer Price Index (CPI) is used for inflation. In Pakistan, the inflation rate is mainly driven by current and past fiscal and monetary policies, international commodity prices, USD exchange rate, seasonal factors and economic agents' expectations concerning the future developments of these indicators. Also, structural government policies to improve the functioning of markets and in particular, the food markets play an important role.

In Pakistan, Aug 2008 is the period which recorded the highest YoY inflation while Jun 2003 is the period of lowest inflation.

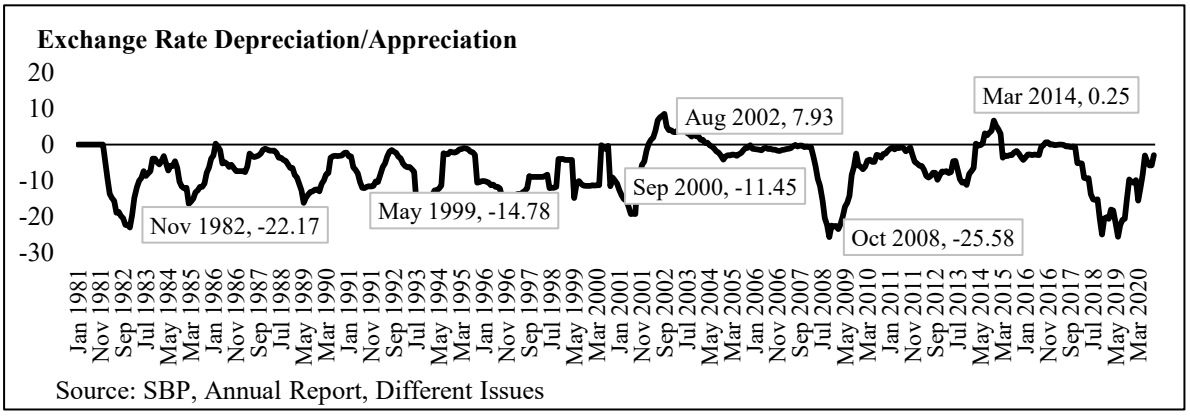


Source: Pakistan Economic Survey, Different Issues

## Exchange rate

The value of the nation's exchange in terms of other nations' exchange. Exchange rates affect the true prices of commodities traded among countries of the world. Nevertheless, exchange rate volatility represents the unpredictability of international trade in goods and financial assets alike. In Pakistan, the exchange rate movement remained volatile although the regime changed from fixed to floating exchange rate. Usually, most of the time, depreciation was observed with the highest depreciation of 26 percent in Oct 2008, while initially in earlier in Nov 1982, it was depreciated by 22 percent. Some years especially from Feb 2002 to Apr 2004,

appreciation in currency was also observed, with the highest appreciation of 8 percent occurring in Aug 2002.



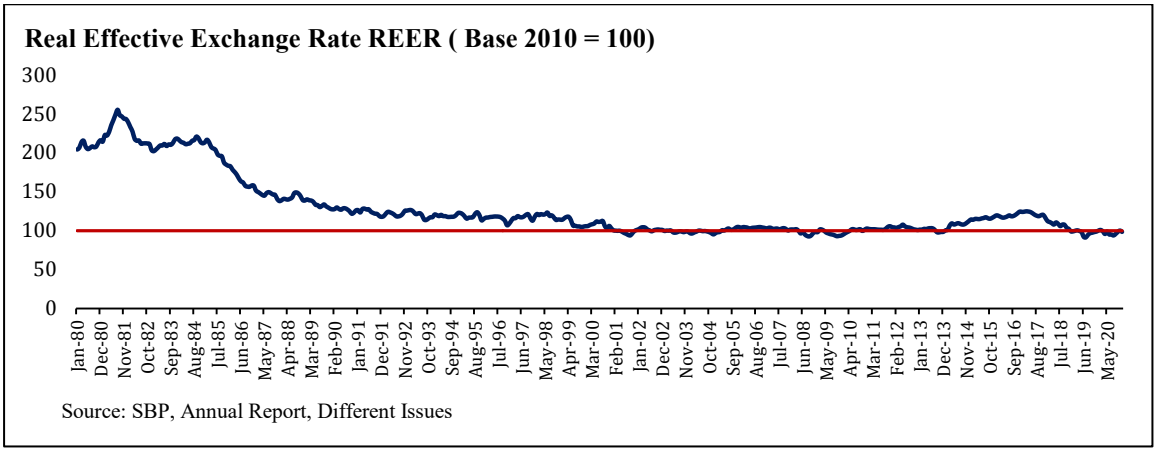
Source: SBP, Annual Report, Different Issues

After 1982, when the rupee was allowed to float freely, its value began to fall, most notably between January 1982 and June 1996. Throughout the majority of the 1980s, the crawling peg caused movement or a floating exchange rate when the State Bank of Pakistan depreciated the rupee in small increments whenever necessary, but since 1993, these depreciations have been directly supported by devaluations in the name of technical adjustments. After July 2001, the government chose to allow the currency rate to float freely, resulting in dramatic variations in the real exchange rate, which, after nearly reaching a peak of Rs 64 in 2002, displays a downward trend (appreciation) during periods when market forces favored Pakistan.

**Real Effective Exchange Rate**

Nevertheless, exchange rate fluctuation along with exchange rate volatility represents the unpredictability of international trade in goods and financial assets alike. In Pakistan, the exchange rate movement remained volatile although the regime changed from fixed to floating exchange rate. REER (Real Effective Exchange Rates) index was used to determine the value of a currency in relation to a weighted average of several foreign currencies divided by a price deflator. Further, following international practices, SBP started calculating REER indices since July 1972 and is

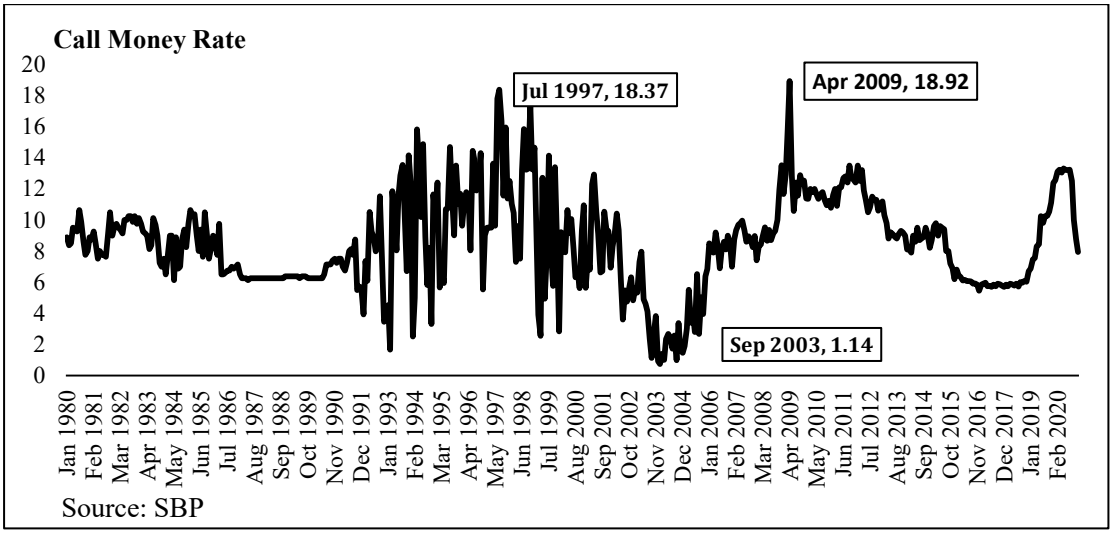
regularly publishing it on a monthly frequency. Further REER being indices is published with reference to some base year. Presently, 2010 is being used as the base year by SBP.




**Interest rate**

Globally, the interest rate is the tool used by the central bank to anchor inflation. According to the SBP Act 1956, the SBP is tasked with the aims of containing inflation and sustaining strong economic growth, as well as implementing the exchange rate policy. In the context of the present research, the inclusion of interest rates is based on the fact that a strong domestic currency serves as a drag on the economy, producing the same effect as monetary policy tightening (i.e., higher interest rates). Further, greater monetary tightening at a time when the domestic currency is already strong may compound the problem by attracting hot money from foreign investors seeking higher-yielding investments (which would further strengthen the domestic currency). If aggregate demand is aggressive, raising interest rate thus constrained aggregate demand and thus controls inflation from the demand-side. Further, a raise in interest rate can affect investment and hence economic activities. In the research, the call money rate (CMR) is used as a proxy for the policy rate.

The movement of CMR remained volatile with the highest peak of 18.4 percent in July 1997 and the lowest of 1.14 percent in Sep 2003. Until 1982, the currency rate was set; it was then replaced with a controlled float. Throughout the 1970s and 1990s, SBP's monetary policy was restricted and focused mostly on dispensing subsidized directed credits to priority sectors.



Source: SBP

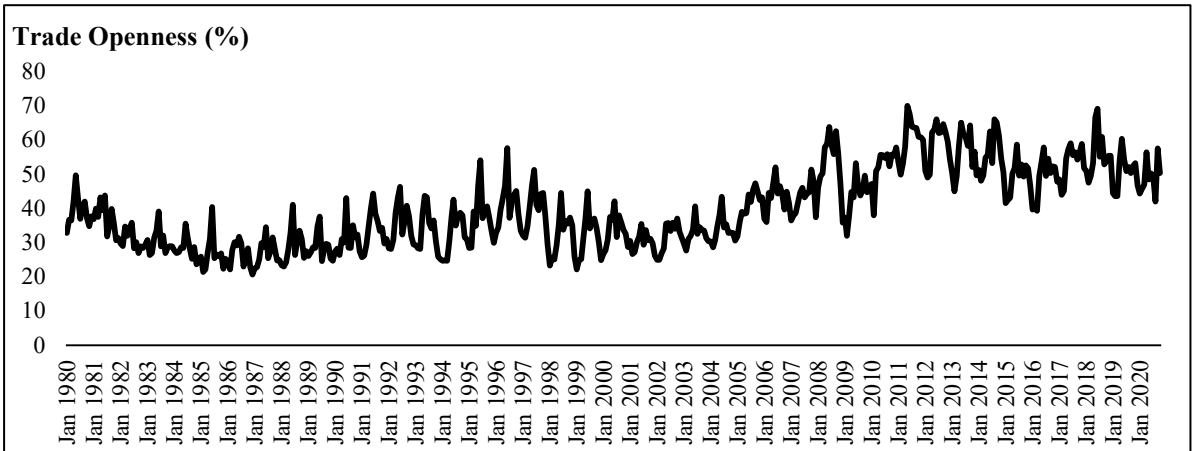
This was due to the fact that this overnight interbank interest rate was left as the outcome of market forces of supply and demand. Further, SBP adopted a new framework for its monetary operations on August 17, 2009, by introducing a 300-basis points corridor for the money market overnight repo rate. In this framework, the SBP reverse repo rate serves as a 'ceiling' and the SBP repo rate provides a 'floor' to the corridor. It resulted in a significant reduction of the CMR volatility. The volatility was further reduced when with effect from February 11, 2013, the width of the corridor has been reduced to 250 basis points. A significant further step in the reduction of the volatility of the overnight interbank rate occurred when in May 2015, SBP announced changes in the existing Monetary Policy Framework by introducing the SBP Policy (target) Rate. SBP has introduced the new Policy (target) Rate to unambiguously signal SBP's stance of monetary policy. SBP reverse repo rate (ceiling) and repo rate (floor) are set at +50 bps and -150bps from the Policy (target)

Rate. SBP has increased the frequency of OMO repo operations of varying tenors including overnight to ensure that the money market overnight repo rate remains close to this target rate.

**Trade openness**

Trade Openness is the sum of imports and exports normalized by GDP. One indicator of the degree to which a nation is engaged in the global trading system is trade openness. In general, trade openness is calculated by the ratio of the number of exports and imports to the gross domestic product (GDP). Compared to domestic transactions, the trade-to - GDP ratio is also used to calculate the value of international transactions. Trade openness is argued to bring many economic benefits, including increased technology transfer, skills transfer, increased labor, and the overall productivity factor, as well as economic growth and development.

Although, Pakistan from the day of independence started the multilateral trading system, however, excessive regulations, government interventions and uncertain



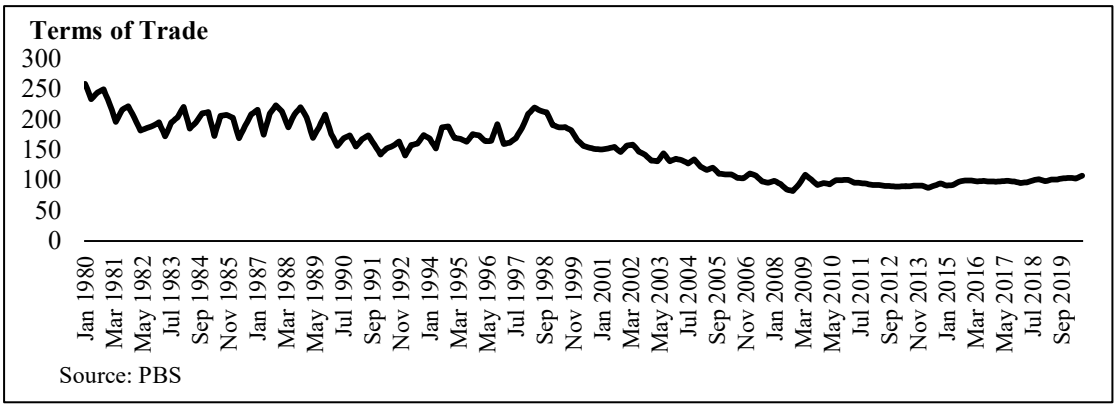
Source: Author's Calculation using Pakistan Economic Survey, Different Issues

economic effects trade openness quite significantly. Further, different opinions especially in the research were seen in the context of the relationship between trade openness and GDP growth. Siddiqui and Iqbal (2010) studied the data on trade openness and GDP growth for Pakistan from the time period 1972 to 2002 to find out the relationship between the variables and concluded that openness of trade has a negative relationship with the economic growth of the country.

**Terms of Trade**

The trade terms (TOT) reflect the ratio between the export prices of a country and its import prices. The ratio is determined by dividing the export price by the import price and multiplying the result by 100 percent. It is to mention that if the terms of trade of a country change, it means that it can purchase more units of imported products for every unit of exports sold. If the terms of trade of a country change, it means that it can purchase more units of imported products for every unit of exports sold. As an increase implies declining import prices relative to export prices, it may also have a beneficial impact on domestic cost-push inflation.

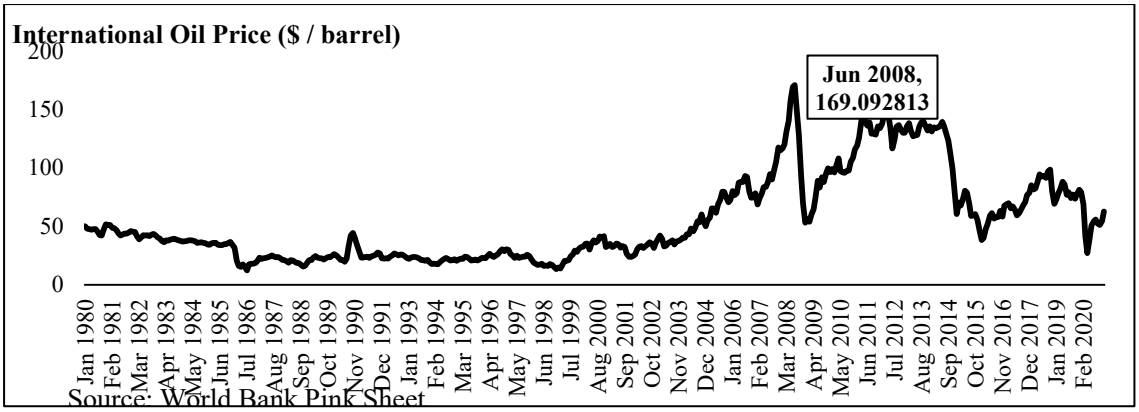
Pakistan Bureau of Statistics published the data of Terms of Trade on a quarterly base of the year 1990-91=100. It was harmonized with other real variables. Although trade




openness improved dramatically over time in Pakistan, it remained volatile due to the country's lack of diversification in production and exports. This makes it susceptible to severe market changes and shocks. Thus, the terms of trade remained fluctuated and deteriorated over time, also due to volatility in economic activities as evident from the figure below:

**Oil Prices**

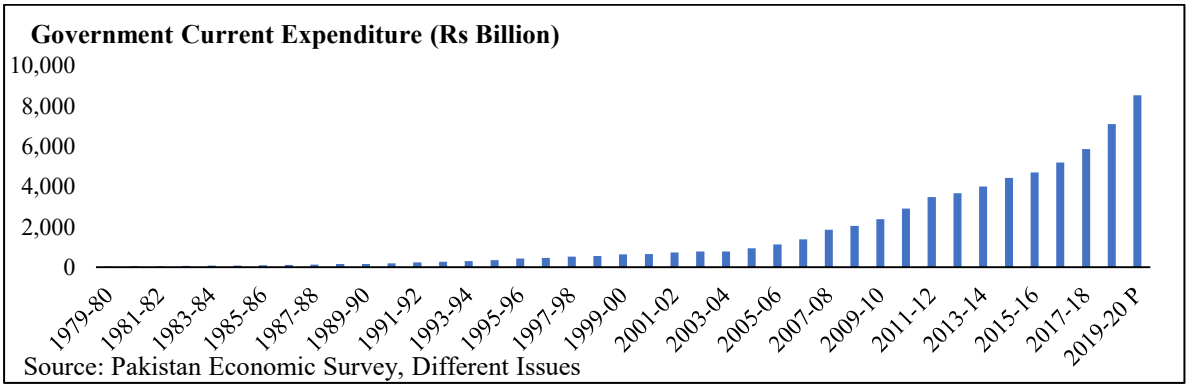
Historically, oil prices remained volatile in response to international events. However, Oil prices are also influenced by other factors, particularly the decisions about output made by producers like the Organization of Petroleum Exporting Countries (OPEC), demand-supply gap, natural disasters, production costs, storage capacity, etc. Before 2014, OPEC vowed to keep the price of oil above $100 a barrel for the foreseeable future, but midway through that year, the price of oil began to tumble. It fell from a peak of above $100 a barrel to below $50 a barrel. OPEC was the major cause of cheap oil in that instance, as it refused to cut oil production, leading to a tumble in prices. Although rising oil prices give benefit to oil-exporting countries, this becomes an external balance risk to oil promoting countries especially Pakistan in which oil is the major input of all economic activities.



Source: World Bank Pink Sheet

## Government Consumption

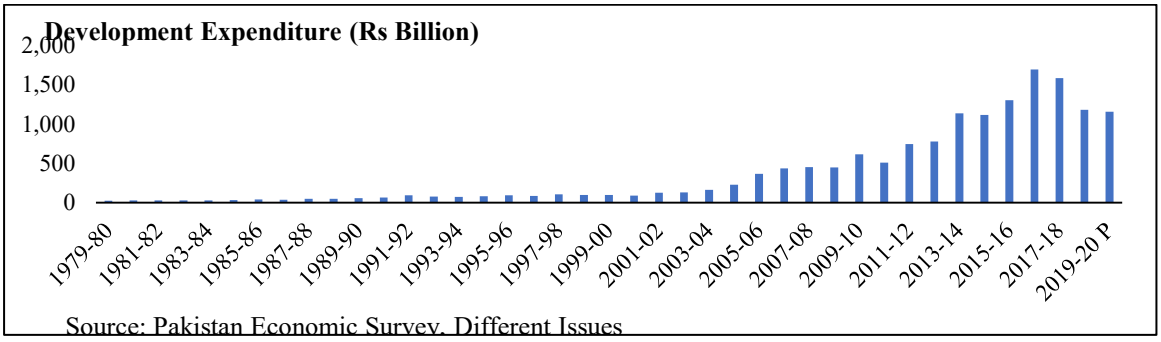
Government consumption expenditure is defined as "Expenditure incurred by the general government sector on goods and services that are used for the direct satisfaction of individual needs or wants or expenditure on the collective needs of the members of the community". Many challenges in the economy of Pakistan stems from insufficient investments by the government in critical areas of the economy, mainly because a very large portion of fiscal resources are consumed by the following expenditures: the large interest cost of public debt, high administrative and defense spending, a large electricity subsidy and losses of state-owned enterprises. In addition, the government does not get the full value for money from the expenditure it is able to make in key areas. As a consequence, Pakistan's long-term productivity is declining which does not bode well for future prospective. Although government consumption increases significantly over time, however, interest rate, defense and pay & pension are the major components of Government Consumption Expenditures.



Source: Pakistan Economic Survey, Different Issues

## Government Investment

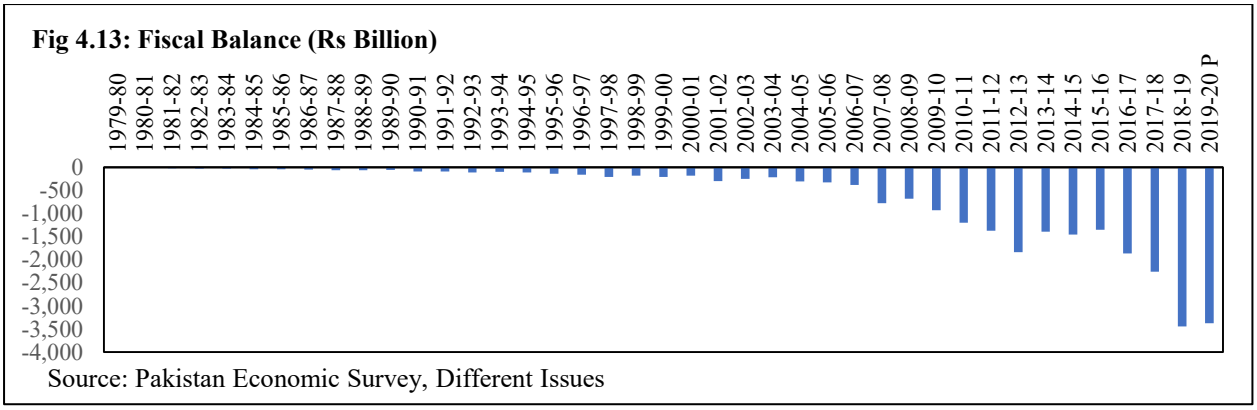
Government Investment means expenditure on capital spending, e.g., buying new machines, building bigger factories, and buying robots to enable automation. Government investment is usually discussed in the context of development expenditure. Although after the 18th amendment, each province also spent an amount on development especially education, health etc., while Federal Government makes development through PSDP and mainly the projects are related to infrastructure. It has been observed previously that if revenues fell short, the federal government restrict the fiscal deficit by curtailing development expenditures. In the recent era, the process of funding has been improved and the usually allocated amount of PSDP is spent by all means. Hence Government Development Expenditures are used for proxy of Government Investment.



Source: Pakistan Economic Survey, Different Issues

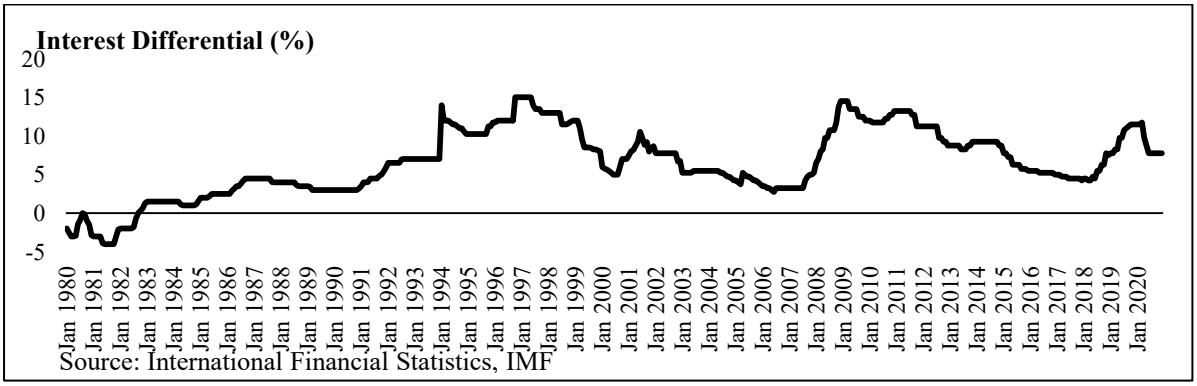
## Fiscal Deficit

If government revenues continue to fall short of expenditures, the overall impact is on fiscal deficit. Historically, with the expansion of the economy, both revenue and expenditure of government have been increased significantly which also translated to a higher fiscal deficit. Prior to the present IMF program, the government was continuously financing the fiscal deficit by borrowing from SBP. However, in the recent IMF program, the federal government cannot borrow from SBP. In nominal value, the Fiscal deficit was higher in FY 2019, mainly due to high-interest payments.




### Interest Differentials

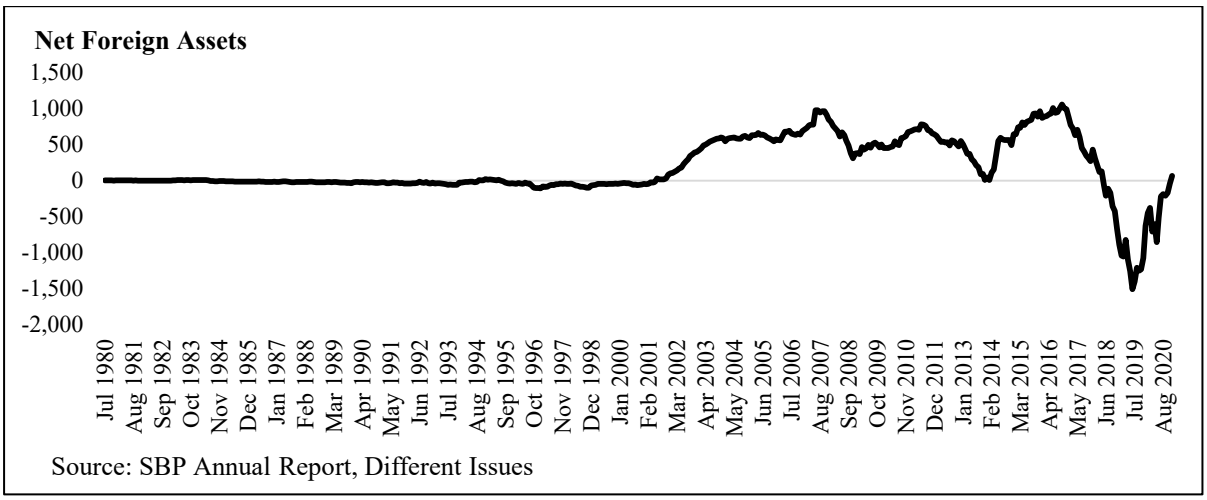
When comparing two equivalent interest-bearing assets from two different nations, the interest rate differential is taken into account. In present study, interest rate differential is taken as the difference between interest rates in the United States and Pakistan. Thus, traders or investors can create an expectation of the future based on the exchange rate between two currencies as well as interest differentials.




### Net Foreign Assets

Net Foreign Assets (NFAs) are the value of a country's owned foreign assets minus the value of its foreign-owned domestic assets, adjusted for valuation and exchange rate movements. The status of a nation's net foreign assets (NFA) is also

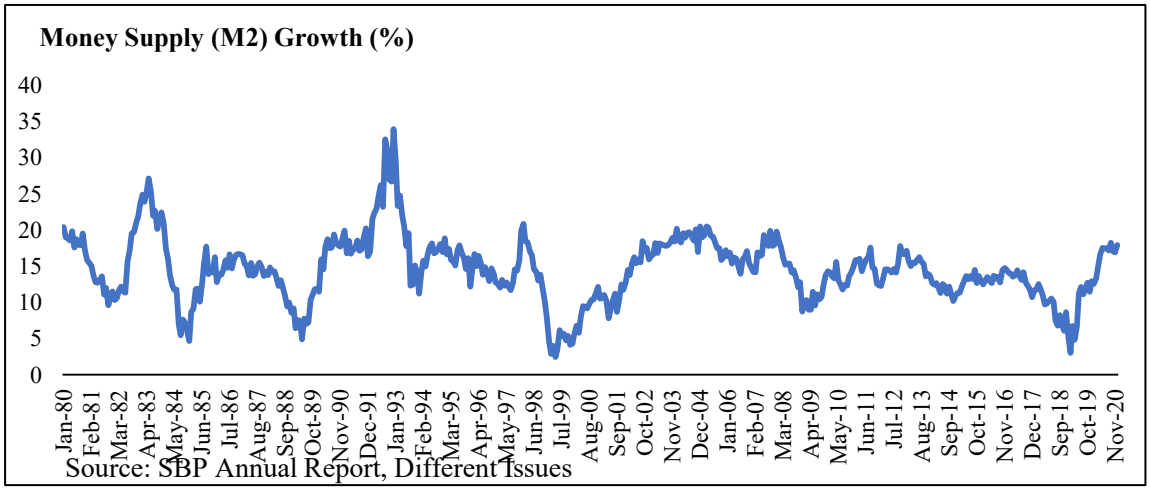
defined as the cumulative change in its current account, which is the amount of trade balance, net revenue over time, and net current transfers over time. The status of net foreign assets shows whether the country is a net creditor to the rest of the world or a debtor. A positive balance of the NFA means it is a net lender, whereas a negative balance of the NFA indicates that it is a net borrower.



Source: SBP Annual Report, Different Issues

**Money Supply**

Over the years the State bank of Pakistan adopted different strategies for the implementation of its monetary policy. The SBP adopted "elective credit/credit ceiling" from the second quarter of the fiscal year 1973 to August 1992, then the "credit to deposit ratio" from September 1992 to September 1995 and the "Money Supply" target in September 1995 (Saqib and Omer, 2008). Although, different monetary policy strategies of SBP were designed to stabilize macroeconomic conditions, however, economic performance remained unsatisfactory. Further, in Pakistan, historically, there always remained a strong and positive correlation between



Source: SBP Annual Report, Different Issues

inflation and monetary growth.

## Appendix C

**Lag length of chapter 5**

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -5352.22 | NA | 89.57 | 24.36 | 24.43 | 24.39 |
| 1 | -1479.07 | 7605.46 | 0.00 | 6.98 | 7.50 | 7.18 |
| 2 | -1305.65 | 335.01 | 0.00 | 6.41 | 7.39* | 6.80* |
| 3 | -1229.55 | 144.61 | 0.00 | 6.29 | 7.72 | 6.85 |
| 4 | -1154.15 | 140.86 | 0.00 | 6.17 | 8.05 | 6.91 |
| 5 | -1100.61 | 98.31 | 0.00 | 6.15 | 8.49 | 7.07 |
| 6 | -1063.28 | 67.37 | 0.00 | 6.20 | 9.00 | 7.30 |
| 7 | -1023.74 | 70.08 | 0.00 | 6.24 | 9.50 | 7.53 |
| 8 | -983.50 | 70.05 | 0.00 | 6.28 | 9.99 | 7.75 |
| 9 | -887.09 | 164.77 | 0.00 | 6.07 | 10.23 | 7.71 |
| 10 | -844.08 | 72.15 | 0.00 | 6.10 | 10.71 | 7.92 |
| 11 | -776.47 | 111.25 | 0.00 | 6.01 | 11.08 | 8.01 |
| 12 | -676.24 | 161.73 | 0.00 | 5.78 | 11.30 | 7.96 |
| 13 | -543.06 | 210.67* | 0.00* | 5.40* | 11.38 | 7.76 |
| 14 | -510.07 | 51.14 | 0.00 | 5.47 | 11.91 | 8.01 |
| 15 | -480.29 | 45.21 | 0.00 | 5.56 | 12.45 | 8.27 |
| 16 | -449.01 | 46.49 | 0.00 | 5.64 | 12.98 | 8.53 |

**Lag length of chapter 6**

| **Lag** | **LogL** | **LR** | **AIC** | **SC** | **HQ** |
|---|---|---|---|---|---|
| 0 | -3280.653 | NA | 13.977 | 14.074 | 14.015 |
| 1 | 5214.729 | 16557.880 | -21.583 | -20.418 | -21.125 |
| 2 | 5701.669 | 926.323 | -23.137 | -20.904* | -22.258* |
| 3 | 5843.337 | 262.883 | -23.224 | -19.925 | -21.926 |
| 4 | 5976.990 | 241.768 | -23.278 | -18.912 | -21.560 |
| 5 | 6092.394 | 203.366 | -23.254 | -17.820 | -21.117 |
| 6 | 6220.143 | 219.153 | -23.282* | -16.782 | -20.725 |
| 7 | 6308.687 | 147.762 | -23.145 | -15.576 | -20.168 |
| 8 | 6401.655 | 150.801* | -23.026 | -14.390 | -19.629 |

**appendix D**

**UNIT ROOT TEST RESULTS TABLE (ADF)**

**Null Hypothesis: the variable has a unit root**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **At Level** | | | | | | | | | | | | |
| | | **INFL** | **CMR** | **LGDP** | **LM2** | **LOIP** | **LSM** | **LREER** | **FD** | **OPENDESE** | **MISREER** | **VOLI** |
| **With Constant** | **t-Statistic** | -2.439 | -3.39 | -2.29 | 2.10 | -2.10 | -0.153 | -1.98 | 2.17 | -2.013 | -2.88 | -19.93 |
| | **P-value** | 0.132 | 0.012 | 0.175 | 0.995 | 0.244 | 0.941 | 0.294 | 1.000 | 0.281 | 0.049 | 0.000 |
| | | n0 | ** | n0 | n0 | n0 | n0 | n0 | n0 | n0 | ** | *** |
| **With Constant & Trend** | **t-Statistic** | -2.424 | -3.415 | -1.694 | -2.509 | -2.960 | -1.646 | -1.563 | 0.341 | -3.573 | -2.871 | -19.911 |
| | **P-value** | 0.367 | 0.051 | 0.753 | 0.324 | 0.145 | 0.773 | 0.806 | 0.999 | 0.033 | 0.173 | 0.000 |
| | | n0 | * | n0 | n0 | n0 | n0 | n0 | n0 | ** | n0 | *** |
| **Without Constant & Trend** | **t-Statistic** | -0.650 | -0.942 | 2.193 | -0.013 | -0.256 | 3.138 | -1.882 | 2.869 | -0.322 | -2.877 | -0.068 |
| | **P-value** | 0.436 | 0.308 | 0.994 | 0.678 | 0.594 | 1.000 | 0.057 | 0.999 | 0.569 | 0.004 | 0.660 |
| | | n0 | n0 | n0 | n0 | n0 | n0 | * | n0 | n0 | *** | n0 |
| **At First Difference** | | | | | | | | | | | | |
| | | **d(INFL)** | **d(CMR)** | **d(LGDP)** | **d(LM2)** | **d(LOIP)** | **d(LSM)** | **d(LREER)** | **d(FD)** | **d(OPENDESE)** | **d(MISREER)** | **d(VOLI)** |
| **With Constant** | **t-Statistic** | -9.597 | -15.309 | -2.848 | 0.877 | -16.023 | -9.553 | -15.213 | -5.812 | -15.523 | -15.292 | -13.475 |
| | **P-value** | 0.000 | 0.000 | 0.053 | 0.067 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | *** | *** | * | * | *** | *** | *** | *** | *** | *** | *** |
| **With Constant & Trend** | **t-Statistic** | -9.609 | -15.293 | -3.508 | 5.509 | -16.006 | -9.545 | -15.278 | -6.350 | -15.525 | -15.294 | -13.482 |
| | **P-value** | 0.000 | 0.000 | 0.040 | 0.022 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | *** | *** | ** | ** | *** | *** | *** | *** | *** | *** | *** |
| **Without Constant & Trend** | **t-Statistic** | -9.607 | -15.325 | -1.605 | 1.350 | -16.039 | -5.992 | -15.076 | -5.467 | -15.539 | -15.304 | -13.485 |
| | **P-value** | 0.000 | 0.000 | 0.001 | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | *** | *** | *** | *** | *** | *** | *** | *** | *** | *** | *** |

**appendix E**
**McLeod and Li (1983) test**

| Price | | Economic activity | |
|---|---|---|---|
| Q-Stat | Prob* | Q-Stat | Prob* |
| 43.165 | 0.000 | 0.5454 | 0.0046 |
| 146.33 | 0.000 | 6.9466 | 0.031 |
| 160.37 | 0.000 | 8.8495 | 0.031 |
| 191.96 | 0.000 | 17.667 | 0.001 |
| 194.62 | 0.000 | 19.009 | 0.002 |
| 197.03 | 0.000 | 19.08 | 0.004 |
| 198.14 | 0.000 | 19.493 | 0.007 |
| 199.11 | 0.000 | 23.777 | 0.002 |
| 199.15 | 0.000 | 23.777 | 0.005 |
| 199.72 | 0.000 | 28.243 | 0.002 |
| 199.81 | 0.000 | 28.994 | 0.002 |
| 200.33 | 0.000 | 146.33 | 0.000 |
| 200.37 | 0.000 | 146.58 | 0.000 |
| 200.63 | 0.000 | 146.74 | 0.000 |
| 200.71 | 0.000 | 147.86 | 0.000 |
| 200.99 | 0.000 | 164.54 | 0.000 |
| 201.14 | 0.000 | 167.16 | 0.000 |
| 201.14 | 0.000 | 167.72 | 0.000 |
| 201.51 | 0.000 | 168.01 | 0.000 |
| 202.1 | 0.000 | 171.03 | 0.000 |
| 202.74 | 0.000 | 172.31 | 0.000 |
| 203.56 | 0.000 | 180.11 | 0.000 |
| 203.73 | 0.000 | 190.76 | 0.000 |
| 203.74 | 0.000 | 229.21 | 0.000 |
| 203.92 | 0.000 | 229.86 | 0.000 |
| 203.98 | 0.000 | 229.86 | 0.000 |
| 204.16 | 0.000 | 234.18 | 0.000 |
| 204.28 | 0.000 | 244.43 | 0.000 |
| 204.69 | 0.000 | 244.43 | 0.000 |
| 205.02 | 0.000 | 246.29 | 0.000 |
| 205.6 | 0.000 | 246.46 | 0.000 |
| 206.2 | 0.000 | 246.92 | 0.000 |
| 206.49 | 0.000 | 250.36 | 0.000 |
| 207.34 | 0.000 | 255 | 0.000 |
| 207.94 | 0.000 | 270.43 | 0.000 |
| 208.41 | 0.000 | 291.39 | 0.000 |