CURRENCY DEPRECIATION AND OUTPUT NEXUS: EVIDENCE FROM PAKISTAN

By

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Department of Economics
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A Research Dissertation submitted to the Pakistan Institute of Development Economics (PIDE), Islamabad, in partial fulfillment of the requirements for the award of the degree of Masters of Philosophy in Economics.

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Dedicated to

MY BELOVED FATHER
Mian Zulifqar Ali
Whose Lovable attitude and Sincere Passion towards his job always compel me to do something new and innovative?

Certificate

This is to certify that this research dissertation by Muhammad Nawaz is accepted in its present form by the Department of Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the thesis requirements for the degree of Masters of Philosophy in Economics.

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ABSTRACT

Currency depreciation as a channel of output management has been a hot and controversial topic in both developed and developing economies. In Pakistan's case relevant research would require study of data available for the period 1972 to 2010. The stationarity of the variables under consideration at different orders requires the application of the bounds testing approach to cointegration. The findings based on open economy IS-LM framework induce a negative effect of currency depreciation on output levels. This is consistent with both the cross-correlation scrutiny and the long-run estimates of the auto-regressive distributive lag (ARDL) model. The short-run estimates of error-correction model (ECM) may lead to significant increment in output levels due to the depreciation of Pak-Rupee. Government spending may cause to reduce the output in the short, as well as, in the long-run which furnishes strong support to the crowding-out hypothesis. The terms of trade, positive in the short-run, are negatively related to output in the long, in both versions of the model. However, surprise money has been insignificant in both long and short-run ECM. The country would need a clear long term policy regime that inspires trust of the international community and restores the exporters' confidence.

Chapter 1

INTRODUCTION

1.1. INTRODUCTION

Most of the least developed countries (LDCs) are facing severe deterioration in their foreign exchange reserves, huge deficits in balance of payments, increasing burden of imports, growing shortage and rising cost of energy and the resultant declining productivity. Increasing dependence on international donors such as the International Monetary Fund (IMF) and the World Bank (WB), together with their tough conditions, the inability of LDC-produced goods to compete in the international market; high production cost and high tariff on exports are factors that have been negatively affecting the output levels of these countries. In Pakistan these economic problems have been exacerbated due to political instability, poor governance, frequent resort to monetary interference and usage of fiscal discretion.

Currency depreciation[1] has too often been used as the fiscal stratagem to manage output levels by improving the current account status. Net exports are increased that ultimately result in the raising of output level but, under certain other conditions currency depreciation may result in depreciating the production level. Literature, based on theoretical and empirical findings, exhibits both the contractionary and expansionary effects of devaluation on output.

[1] Depreciation happens in flexible exchange rate system in which exchange rate is determined by the forces of supply and demand; while devaluation happens in fixed exchange rate system in which central bank intervene in the foreign exchange market in order to make the exchange rate according to its desires or willingness to buy and sell the domestic currency for foreign currency.

Traditional research advocates the expansionary effect of currency devaluation/depreciation on output and aggregate demand through elasticities, absorption, and the application of the Keynesian approach. Edwards (1986) and De Silva & Zhu (2004) have mentioned that nominal devaluation may result in expenditure switching, high production of tradable goods, high level of exports, and substitution from imports to domestic goods with the improvement in the external position of a country. Dornbusch's (1988) has evaluated that the expansionary effect of devaluation on aggregate demand leads to increment in output. Krugman & Obstfeld (2003) have demonstrated that there is a reduction in unemployment as well.

Contrary to the conventional economic wisdom, the new structuralism school of thought stresses on the contractionary effect of devaluation on output level [Kandil (2008)]. The *contractionary devaluation problem* critiqued in this literature may arise both from the demand or supply side channels [Edwards (1986)].The demand side channels consist of real balance effect[2], redistribution effect[3], and inelastic import pricing effect and so on. The supply side includes the cost of imported inputs and the wage-inflation channel. According to the supply side channels, contractionary devaluation may increase the cost of imported inputs and reduce aggregate supply that might result in the upward shift of the aggregate supply curve [Krugman & Taylor (1978), Van Wijnbergen (1986)]. In

[2] Deprecation of domestic currency may increase the general price level due to high price of trade-able products as compared to non trade-able products. These higher prices may decrease the real balances $\left(M/P\right)$ of the economy that may result in loss of production.

[3] High prices of trade-able products due to depreciation may increase the relative income of profit earners as compared to wage earners. Wage rigidity along with rise in prices may follow the reduction in real wages $\left(W/P\right)$ that may lead to increase in profit's share and decrease in wage's share in national income {Diaz-Alejandro (1963), Krugman & Taylor (1978) and Barbone & Rivera-Batiz (1987)} and may result in reduction of aggregate demand.

addition to that, collective bargaining agreements and wage indexation in the presence of inflation may also result in the reduction in output supply [Agenor &Montiel (1996)]. However, the empirical literature explains that the combined effect of demand and supply side channels determines the net results of exchange rate fluctuations on real output and price levels [Lizondo & Montiel (1989) and Bahmani-Oskooee & Miteza (2003)].

Hirschman (1949) explains that the devaluation of currency with the initial trade deficit causes loss in real income due to high spending on imports rather than export receipts. In this case, the economy transfers its real income to the rest of the world, as consistent with the general equilibrium framework [Cooper (1971)]. In addition to that, the impact of devaluation on real income and trade balance depends on the Marshall-Lerner elasticities; the low level of elasticities results in contractionary devaluation [Gylfason & Schmid (1983)]. Meade (1951) also points out the unique situation when the Marshall-Lerner condition [4] is not satisfied and currency depreciation produces a contraction.

The monetary effect of devaluation has been a significant factor in lowering output levels through the reduction in real balances [Johnson (1972)]. On the fiscal side, in the presence of an ad valorem tax on exports, the devaluation of domestic currency generates income from the private sector to the government with saving propensity of unity in the short-run. This ultimately results in loss of production [Krugman & Taylor (1978)]. In

[4] The Marshall-Lerner condition states that devaluation improves the trade balance if the devaluation nation's demand elasticity for imports plus the foreign demand elasticity for the nation's export exceed 1. The M-L condition, however, is a long-run condition. In the short-run, devaluation is said to have *J-Curve* effect on the trade balance. For some studies on the effects of devaluation on trade balance, see Rehman *et al.* (1997), Bahmani & Ratha (2004), and Bahmani &Wang (2007).

many LDC economies, resort to devaluation may be caused by the huge external debt that may compel these countries to adopt external policies as the easiest way out. Developing countries are more biased towards high net exports and competition with the foreign sector; they prefer devaluation of their currencies faced with huge external debts. This leads to contraction of outputs [Gylfason & Risager (1984), Van Wijnbergen (1986) and Edwards (1987)]. Moreover, whether the effect of devaluation is contractionary or expansionary depends on its expected or unexpected usage [Burton (1983)].

Empirical research advocates four major approaches that examine the effects of devaluation or currency depreciation on outputs [Domac (1997)]. These are the *control group approach* that splits the effects of devaluation on output from other factors; *the before and after approach* studies the change in country performance with regard to impact of devaluation on output; *the macro-simulation approach* which utilizes the simulation models to evaluate the impact of exchange rate changes on output; *the econometric approach* that applies econometric schemes of time series to analyze the given effect.

1.2. SOME KEY FEATURES OF PAKISTAN'S ECONOMY

Pakistan's economy has been a victim of both political and economic crises since the country's inception when it inherited a virtually insolvent economy with India refusing to pay her its share in the divisible funds of Partition. The earlier years were marred by political instability that aggravated the economic problems of the new country. The country had to seek foreign aid to run the economy and undertake development.

Though subsequently the economy through the first three five year plans had started to look up the 1965 war with India and later the separation of the Eastern wing caused severe distortions and weakening of the economic structure. The post secession economy had to make drastic adjustments necessitating a heavy dose of devaluation of the currency in the early seventies. The exchange rate suffered another big tumbling in 1982[5] with the introduction of a new exchange rate system under a new approach to the forex market. Currency depreciation since 1982 has mostly been in response to the volatility of the petroleum prices and the alarming dwindling of foreign reserves.

1.3. OBJECTIVE OF THE STUDY

Since currency depreciation has been a hot issue in developing countries, especially in Pakistan, due to the persistent political instability in the last three decades and particularly since the arrival of the new century, a separate analysis would be needed to find the association between real (nominal) exchange rate, and output and price levels. This research is therefore aimed at:

- Analyzing how currency depreciation, output and price levels are linked in case of Pakistan both in the short and long-run.
- Separating the effects of nominal and real exchange rate on real output level.

[5] Since the neglecting of fixed exchange rate in April 1982, Pak-rupee has weakened incessantly and persistently against many currencies of the industrial world such as 324.05 percent against the British pound, 406.360 percent against the U.S. dollar, and 986.25 percent against the Japanese yen that is alarmingly situation over the period 1982-2000 (Bhatti, 2001).

- Scrutinizing whether all movements in real GDP come from changes in real exchange rate or nominal exchange rate or the combination of nominal exchange rate and price level?
- Examining whether price levels determine the output level in a given framework in case of Pakistan?

1.4. CONTRIBUTION OF THE STUDY

No published study on Pakistan could be found that specifically discusses the effects of exchange rate changes on output levels. Those that were done in the past could not evaluate the given reaction in case of Pakistan, particularly with the bounds testing approach to autoregressive distributive lag (ARDL) and together with the application of Bivariate-data analysis. This study follows the work of Khan & Knight (1981) and its exertion developed by Edwards (1986) along with the contribution of Krugman & Taylor (1978) in the contractionary devaluation framework.

Particularly, this research deigns to make the following contributions to the existing literature:

- It focuses on Pakistan and analyzes the effects of nominal and real exchange rate, separately on real output level, both in short and long-run by applying the bounds testing approach. In addition to that, it also determines the role of price level in effecting the output level in the country's economy.

- It develops and derives the IS-LM open economy model by employing the basic framework of Krugman & Taylor (1978) and analyzes the effect of change in exchange rate on real output. It also analyzes the empirical work of Edwards (1986) in the presence of fiscal, monetary and th side and finds that it is applicable in case of Pakistan.
- It conducts the Bivariate-data analysis in the context of cross-correlations and Granger-causality of real exchange as well as real GDP along with different transformation process due to the controversy of equilibrium values and compares those results with that of the ARDL approach.

1.5. PLAN OF THE STUDY

The study consists of six chapters. The second chapter reviews the empirical and theoretical work based on currency depreciation/devaluation, output level and price level. The third chapter consists of analytical framework and also captures the derivation of IS-LM open economy model by employing the basic framework of Krugman & Taylor (1978). It also analyzes the effect of real exchange rate on real output. The fourth chapter deals with the data and variables description by showing the nature of data, their sources, and the data format. In addition to that, it also describes the Bivariate-data analysis and econometric techniques used for the estimation of the models. The fifth chapter discusses the estimated results based on the bounds testing approach. Finally, the last chapter concludes the study and points to some policy reforms that may be desirable.

Chapter 2

REVIEW OF LITERATURE

2.1. INTRODUCTION

The theoretical work and empirical studies that have been conducted for different regions or set of regions bring out the ambiguity in the currency devaluation/depreciation channel of output. Several studies show the expansionary effect on output that is strongly supported by Keynesian and Dornbusch's (1988) views; while other studies support the contractionary effect in opposition to traditional views. These contradictory findings are the result of usage of different methodologies, composition of countries, time period under contemplation and the structure of the model [ACAR, (2000)].This chapter briefly reviews the literature using different empirical and theoretical studies. The mechanism is of three categories through which the depreciation channel of output works. The first sub-section considers empirically whether the exchange rate depreciation channel of output is contractionary or expansionary; it also utilizes the studies based on vector auto-regressive (VAR) analysis. The second highlights the review of theoretical studies that develop the linkages between exchange rate and output with some other aspects. The last section discusses some of the general studies of exchange rate evaluation.

2.2. REVIEW OF EMPIRICAL STUDIES

This section presents an assessment of diverse empirical studies that scrutinize the effects of real (nominal) exchange rate on output through different channels by using the least square analysis, macro model simulation, panel data analysis, and vector auto-regressive

(VAR) techniques.. For empirical convenience, this section has beeb split into three sub-sections. In the first sub-section, we explain the contractionary impact of devaluation; in the second, the expansionary effect of devaluation is captured, while the last one deals with empirical studies that employ the vector autoregressive (VAR) technique which may lead either to contraction or expansion of output.

2.2.1. Contractionary Devaluation Hypothesis

There exists ample literature on the contractionary devaluation hypothesis based on the experience of developing countries pursuing unresponsive or devaluation-biased policies. Edwards (1986) is the first empirical study of a set of 12 developing countries during 1965-1980. It analyzes the issue employing the monetary, fiscal and external variables to develop the relationship between real exchange rate and output. The findings based on the fixed-effect procedure and reduced- form level- output equation specify that in the short-run devaluation exerts a contractionary effect on output but, after one year, real devaluation starts showing an expansionary effect on output growth which lasts a while finally neutralizing in the long run.

Solimano (1986) examines the effect of currency devaluation on output, employment and trade balance for a small open economy like Chile's. The author points out that these effects depend on the size of foreign trade elasticities, the cost structure of the traded goods industries and the behavior assumed for nominal wages in the economy. The empirical findings show that devaluation has a contractionary impact on output in the short to medium run as 25 per cent devaluation with fixed nominal wages and initial trade

balance reduce the gross national product (GNP) by 3 per cent in the first two quarters. The author also points out that the Marshall-Lerner condition is not satisfied in the short to medium run; the contractionary impact of devaluation disappears within two and half years.

Agenor (1991) scrutinizes the effect of change in RER on output for 23 countries by employing the data set over the period 1978-87. For empirical estimation, the author employs the rational expectations macro-model with imported intermediate goods and derives the aggregate output equation. The study finds that anticipated depreciation is contractionary and unanticipated depreciation is expansionary in effect on economic activity. The results of his study are contrary to Edwards' (1986) in terms of long term contractionary effect on output.

Kamin (1995) explains the contractionary devaluation hypothesis in the event there is a black market for foreign exchange. The study develops the macroeconomic model of black market for dollars and conducts numerical simulation exercise of output elasticities. The findings imply that the contractionary effect of devaluation is lessened when there is a black market for foreign exchange in comparison with conditions under the prevalence of official rates. Iscan (1997) considers the correlation between currency devaluation and output growth by using the sector-wise data for Mexican economy during 1970 to 1991. The author employs the random coefficient regression model for major devaluations of 1976, 1982 and 1986. The empirical outcomes show that in the short-run the

contractionary affect of devaluation the non-agriculture sector with major contraction occurring in the manufacturing sector.

Upadhyay (1999) scrutinizes the effect of currency devaluation on output growth for two sets of countries, "South Asia" and "South East Asia". The author employs two approaches for exchange rate valuation and analyzes the effect of both real and nominal exchange rate on output. The empirical results indicate that real and nominal devaluation have hardly any effect on output growth for the given set of countries. Moreover, the findings are also consistent with the crowding-out hypothesis[6] but find little support in the rational expectation hypothesis (surprised money shock).

Upadhyay and Upadhyay (1999) also observe the impact of currency devaluation on aggregate output in the long run by using data of six Asian countries. The empirical findings derived from employment of the standard technique show that in the long run devaluation in general has a neutral effect on the economy while in Pakistan and Thailand currency devaluation has demonstrated a contractionary effect. The results for short-run show that currency devaluation is positive in India and the Philippines but negative in Pakistan. ACAR (2000) extends the study of currency depreciation by using data series from 1970-1994 for a set of 18 LDCs and divides them into three categories relating to manufacturing, agriculture and primary product exporters. The regression results based on fixed effect procedure in panel estimation imply that real depreciation is favorable for contractionary hypothesis in the short-run and expansionary in the medium-run, while in

[6] It explains that increase in government expenditure leads to increase in nominal interest rate and higher interest rate discourages private investment. Reduction in investment may have contractionary impact on output level of the economy. In this way, government spending leads to the reduction in output level.

the long run the effect tends to taper off. The study also supports the *rational expectation* literature that is consistent with Edwards (1986).

Rajan and Shen (2001) in their empirical study of 25 crisis-ridden Asian countries during the period 1981 to 1999 test five research hypotheses namely "income effect" based on the New Structuralist hypothesis, "Regional effect", "Twin crisis such as banking crisis and currency crisis", "Excessive Debt effect" and "Corruption effect". The findings show that currency devaluation is expansionary during normal periods, while it leads to contraction during crisis-periods for Asian economies. Another empirical study of crisis-affected Asian economies by Chou and Cho (2001) through the panel unit-root test shows that non-stationarity of the series at the same order requires the use of the ARDL model. The findings for crisis-ridden Asian countries demonstrate that devaluation is contractionary in the short-run but becomes ineffective in the long-run.

Miteza (2006) securitizes the impact of devaluation on output for five transition economies of European Union states[7] by employing the quarterly data set over the period 1993 to 2000. The study follows the work of Mills and Pentecost (2001) that amalgamates the real product wage as another explanatory variable along with real exchange rate. The author uses the panel unit root test and panel cointegration technique in order to trace the existence of long-run correlation in the series. The conclusion suggests the existence of long-run correlation among real exchange rate, real output, real

[7] These countries include the Czech Republic, Hungry, Poland, Romania, and Slovak Republic. All are European member since May 2004, excluding Romania, which joined it in 2007.

money and real wages. In addition, it also supports the idea of contractionary devaluation hypothesis for the given five transition economies.

Kandil *et al.* (2008) examine the effect of exchange rate fluctuation on economic activity in Turkey over the period 1980-2004. The authors employ the theoretical rational-expectation model that decomposes the fluctuation in exchange rate into anticipated and unanticipated components. The study also utilizes other explanatory variables such as the growth rate of monetary and fiscal variables along with the dummy variable of structural breaks. The empirical findings by using the three stages least square (3SLS) method suggest that the anticipated exchange rate fluctuation reduces the output growth while unanticipated depreciation decreases it alongwith, consumption and investment growth, but increases the export growth.

Ratha *et al.* (2007) consider the issue of currency devaluation and economic growth in case of China over the period 1977-2006. The authors employ the "bounds-testing approach" and error-correction mechanism to determine the cointegration level and short-run relations. The study finds that overvaluation promotes growth i.e. devaluation is contractionary in the short-run. Kalyoncu *et al.* (2008) explain the effect of currency devaluation on output growth for 23 OECD countries by assessing the time series' properties. The study suggests that in the long-run currency devaluation has negative impact on output expansion in six and positive impact in three countries, while in the short-run, currency depreciation leads to reduction in output in three and increase in two countries. Bahmani-oskooee and Kutan (2008) analyze the effect of real depreciation on domestic output levels for nine emerging economies of Eastern Europe. The study uses

the bounds testing approach and ECM. It concludes that real depreciation is expansionary in some countries and contractionary in others countries but has no effect in one country out of the nine.

Kandil (2008) again employs the theoretical rational expectation model for a set of fifty developing countries during 1960-2000 and decomposes the exchange rate movements into anticipated and unanticipated components. The results show that unanticipated depreciation due to positive shock in exchange rate increases net exports and money demand but decreases the output level[8]. The author also points out that demand-side channels dominate the supply-side channels in determining the outcome of unanticipated currency depreciation. Bahmani-oskooee and Kandil (2009) also securitize the same issue for MENA[9] countries by using annual data over the period 1970-2004 and separating the impact of anticipated and unanticipated component. The result based on the bounds testing approach to cointegration and ECM appraise that unanticipated exchange rate depreciation has no expansionary effect in the long run. The anticipated currency deprecation has a contractionary or expansionary effect on output depending on the cost of imported goods or competitiveness channel.

Sencicek and Upadhyay (2010) employ the time series properties in case of Turkey for the period 1970 to 2004 and conclude that expansionary fiscal policy and improvements in terms of trade have a positive effect on the level of output. The results also show that devaluation is contractionary in the short, expansionary in medium and neutral in the long

[8] These results are also consistent with the Kandil *et al.* (2008).
[9] MENA stand for Middle East and North African countries.

run. In addition to that, the rational expectation hypothesis is valid in case of Turkey. The effect on output comes from nominal devaluation, not from the change in relative price.

The literature cited above strongly supports the contractionary effect of currency depreciation on the output level in contrast to conventional wisdom. We will now take up the contribution of empirical literature in favor of traditional or Dornbusch's (1988) views in the following sub-section.

2.2.2. Expansionary Devaluation Hypothesis

Theoretical literature on currency depreciation/devaluation explains the expansionary effect on output level. On the empirical side, there exist few studies that are consistent with conventional wisdom[10]. This sub-section discusses the contribution of such empirical work that supports the expansionary effect of currency devaluation on the economy.

Gylfason and Schmid (1983) develop a simple macro-economic model to study the possible effects of devaluation on output. The authors also estimate the structural parameters of the model for a set of 10 industrial and developing countries. They conclude that the expansionary effect of devaluation appears in short to medium-run which is consistent with the established analysis.

Anker and Bahmani-Oskooee (2001) examine the relationship between Deutsche mark (DM) and German production by adding quarterly data set over the period 1972-1996.

[10] It define that currency devaluation has expansionary effect on output and employment.

The study gives an idea that the depreciation of Deutsche mark (DM) is expansionary in long-run. Bahmani-Oskooee *et al*. (2002) again assess the same phenomena for selected Asian countries by incorporating the data period from 1976:I-1999:IV. The authors make use of Johnson cointegration and conclude that short and long-run estimates are ambiguous for the given region. The findings propose that output is expansionary for Philippines and Thailand while contractionary for Indonesia and Malaysia. But the results are insignificant in case of South Korean economy.

Upadhyay *et al.* (2004) conduct panel empirical study of Greek and Cypriot economies by using the data set from 1969 to 1998. They scrutinize the time series properties of the annual data by conducting unit-root and cointegration test. They find that the exchange rate depreciation is expansionary in short-run but neutral in medium and long-run. Bebczuk *et al.* (2006) explore a new dimension by incorporating the role of liability dollarization in determining the effect of real devaluation on economic growth. The study using different forms of panel modeling examines data over the years 1976-2003 for a set of 56 industrial and developing countries. The regression results suggest that with no external dollarization, 20 percent real devaluation increases the per-capita GDP by half percentage point and contractionary effect results for countries that have external dollarization greater than 0.84 (greater than 84% dollar denominated external debt's countries).

Narayan and Narayan (2007) develop the nexus between currency devaluation and output level by using the data series over the period 1970 to 2000 for Fiji's economy. The study

uses the multivariate model and employs the bounds testing approach to cointegration and ARDL model for short and long-run dynamic. The empirical results indicate that 10 percent devaluation increases the output by 2.3 percent and 3.3 percent in short and long-run, respectively. However, a 10 percent increase in money supply increases the output by 2.3 percent and 3.4 percent, while government spending is statistically insignificant and foreign income is statistically significant.

Bahmani-Oskooee *et al.* (2008) explore the new dimension for 29 LDCs over the period 1975-1998. The study highlights that capital control problem in many LDC economies leads to the creation of a black market for foreign exchange. For this reason it employs the black market exchange rate instead of official exchange rate for panel unit root and panel cointegration analysis. The authors also conduct sensitivity analysis by using different panel econometric models such as panel LS, least square dummy variable (LSDV), Random Effect model and Maximum likelihood method. The empirical findings suggest that real depreciation of black market exchange rate is expansionary in LDCs. Ratha (2010) employs the bound testing approach to cointegration for the Indian economy during 1970-2006. The empirical findings show that nominal devaluation of the rupee leads to real devaluation and that currency devaluation is expansionary in India in accordance with theoretical literature which contradicts previous empirical studies such as by Gylfason & Schmid (1983) and Bahmani-Oskooee (1998).

2.2.3. Review of Vector Autoregressive (VAR) Studies

Different empirical methodologies have been developed with the passage of time along with alternative improved techniques or approaches to handle any issue. These may or may not contradict the findings of conventional technique(s). This sub-section contains the review of empirical studies that provide the work of vector autoregressive (VAR) technique. Literature based on the contractionary devaluation issue abounds but few studies utilize it and, interestingly, its findings do not contradict the results of the traditional techniques.

Kamin and Rogers (2000) estimate VAR model for the Mexican economy by using quarterly data from 1980: I through 1996: II. The study explains that there exists a spurious correlation between the real exchange rate and real GDP, and causality runs from real exchange rate to output. The authors employ different models in VARs analysis by including or excluding different variables and conclude that real devaluation is consistent with persistent high inflation and economic contraction.

Odusola and Akinlo (2001) employ the structural VAR model for the Nigerian economy by using the data series from 1970: I to 1995: IV. The study is also subjected to the impulse response functions (IRFs) and variance decomposition. The study concludes that exchange rate depreciation has expansionary effect on output in both medium and long-run while in the short run the effect is contractionary. The results from contemporaneous model also show a contractionary impact of parallel exchange rate on output level. Berument and Pasaogullari (2003) assess the effects of real depreciation on output and

inflation in case of Turkey by considering the quarterly data from 1987: I to 2001: III. The authors use bivariate analysis and find a negative correlation between output and real exchange rate. The existence of a long-run correlation among key variables requires the implication of VAR analysis. The study also uses other important variables such as US interest rate, government size, capital and current accounts. It concludes that devaluation is contractionary, i.e. high price and low output.

De-Silva and Zhu (2004) examine the effect of exchange rate on GDP and trade balance by employing the VAR and ECM in case of the Sri-lankan economy. The authors clarify that variation in exchange rate explicates the fluctuations in trade balance (export/import) and GDP growth. The findings show that new exchange rate policy supports the improvements in trade balance and contractionary effect appears when devaluation process is continued.

Kim and Ying (2007) empirically test the contractionary devaluation hypothesis for seven East Asian countries and two Latin American countries namely “Chile” and “Mexico” by using quarterly data set. The authors conduct Bivariate cross-correlation, causality test and IRFs and variance decomposition for VAR analysis. The findings suggest that East Asian economies experienced expansionary devaluation for the data set before the financial crisis which is contrary to the experience of Chile and Mexico. But the inclusion of post-crisis data reverses the results for East Asian economies also, a trend that is consistent with the two Latin American countries. Nishigaki (2007) explores the new

dimension in contractionary framework by employing the East Asian[11] countries. The study employs the monthly data from 1994 to 2006 and SVAR analysis. The results based on IRF's indicate that East Asian currency appreciation lead to expansion in output and high US net exports to East Asian economies.

Ramly and Abdel-Haleim (2008) consider the correlation between exchange rate and output for the Egyptian economy using the annual data for 1982-2004. The authors estimate the VAR model based on the endogenous variable real GDP, the real effective exchange rate, M2, and the fiscal deficit for structural analysis namely, IRFs and forecast error-variance decomposition. The empirical results show that the contractionary effect of devaluation remained evident for four years before the expansionary effect surfaced; and the variation in the real exchange rate explains 45 percent to 68 percent changes the in rate of output growth. This extensive review of empirical literature through different econometric techniques clearly explicates that the exchange rate channel of output is a controversial issue. In the following section this trend is reviewed in the light of theoretical literature.

2.3. REVIEW OF THEORATICAL STUDIES

Guitian (1976) builds up a general equilibrium model to analyze the effects of fiscal, credit and exchange rate policies on domestic price level, balance of payments and output level. The author clarifies that on the demand side, budget deficit financed by domestic credit expansion increases the price and output level while on the supply side soaring

[11] The East Asian countries are Japan, China, Hong Kong, Taiwan, Korea, Singapore, Thailand, Malaysia, Philippines and Indonesia.

prices are consistent with falling output level. The study also evaluates two policy options to bring the system back into equilibrium: first, by stopping support to aggregate demand that results in deflationary process and second, by supporting currency devaluation that results in price increase of tradable goods and improvement in balance of payments. The theoretical findings show that in the long run, it is the supply side that determines the rate of growth in output and employment.

Hanson (1983) develops a macroeconomic model of currency devaluation incorporating the labour market in the study as well as the possibility of substitution in production and consumption. The author points out that the impact of devaluation on output depends on the sign of one plus the weighted sum of price elasticities of demand for imported consumer goods and imported inputs. The expansionary situation entails a less than one sign while the contractionary situation demonstrates extremely low elasticities and a larger trade deficit. The study also reveals that the possibility of substitution in consumption and production reduces the contractionary impact of currency devaluation and the flexibility of wages also decreases its contractionary impact on the labor market.

Burton (1983) builds a small open economy model to study the effects of both devaluation and expected devaluation on output, prices and foreign exchange reserves under the assumption of rational expectation and wage contracts. The study shows that unanticipated devaluation has an expansionary and anticipated devaluation has a contractionary impact on output. It also explains that devaluation increases foreign

exchange reserves (on account of increase in prices) or both the price and output level but expected devaluation causes a fall in reserves before the time period.

Islam (1984) compares alternative policy options like the impact of devaluation, monetary contraction and tariff/subsidy policy on output, price level and trade balance taking into account the input of imported intermediates, partial wage indexation and larger initial trade deficit. The study indicates that devaluation is consistent with high prices, short-fall in GNP and output in home goods sector and high trade deficit measured in domestic currency, while a contractionary monetary policy depends on balance of payments position and inflation objectives in case of low output. However, a tariff/subsidy policy attains the balance of payments objective without any significant supply side effects.

Barbone and Batiz (1987) utilize the short-run macroeconomic model of Krugman & Taylor (1978) and analyze the impact of currency devaluation in a small open economy (Jamaica) which is host to private foreign direct investment. The author points out that in the short run, devaluation with rigid nominal wages, boosts the prices of home goods and redistributes income from one class (Wages) to another (Profit). This may increase the outflow in consumption with diminution in real wages. It also exerts a contractionary effect on output due to downturn in aggregate demand in the Keynesian context. The authors also specify that this negative impact on the national product is more severe due to escalating claims of foreign capital on domestic output. Hence, GNP is more affected

than GDP. The authors' analysis of the 1980 data on Jamaican economy reveals that the negative effect of devaluation on GNP is greater in the presence of foreign capital.

Lizondo and Montiel (1989) evaluate the impact of devaluation on output in developing countries using a wider general framework. They find that on the demand side, the impact of real devaluation depends on the balance of trade; if it is in deficit, real income falls; if its in surplus real income rises. The supply side effects cause an upward shift in the relevant curve since channels like increase in nominal wages, the use of imported input and increase in the cost of working capital raise prices and lower output levels. The findings suggest that analytically the net effect of devaluation on output is ambiguous.

Gylfason and Radetzki (1991) widen the macroeconomic model of contractionary devaluation and empirically estimate the six structural parameters of the model for 12 developing countries. The authors have to rely on assumptions due to non availability of data.. The findings based on empirical simulations indicate that 10 per cent devaluation improves the current account by 0.7 percent to 2.8 percent of GNP in the short to medium-run, or by 1.5 percent of GNP on average. In case of fixed nominal wages, 10 percent devaluation lowers the GNP by 0.5 percent and real wage earnings by 2.9 percent on average. The full indexation of wages causes to lower GNP more than earlier, by 1.4 percent on average.

Ali and Scarth (1994) also examine the issue of currency devaluation in the context of the Correspondence principle. The authors agrees with the views of Buffie (1986) that

"devaluation can contract employment and worsen the payments balance" and includes two additional assumptions to strengthen Buffie's argument. The study also conducts sensitivity and stability analysis for short and long-run effects of devaluation. The results show that short-run analysis supports Buffie's views, while in the long run devaluation has neutral effect on output and balance of payments. Bird and Rajan (2004) develop a theoretical model for exchange rate devaluation and analyze it for Thailand economy. The findings based on mathematical framework suggest that devaluation may contribute to capital outflows, loss of liquidity both directly and indirectly and result in contraction of output.

2.4. REVIEW OF GENERAL LITERATURE

This section highlights some general studies that evaluate the given analysis along with some other aspects both empirical and theoretical. Khan and Knight (1973) develop a model under the stabilization program for developing countries {*Nawaz, whose program is this?}* in order to find the inflation and adverse balance of payments effects. The study analyzes the determination of output, prices, international reserves, money, taxation and expenditure simultaneously. The authors use a pooled sample of annual data for 29 developing countries and find that monetary disequilibrium has a significant effect on the behavior of prices, output and reserves. Another finding also shows that in the short run the stabilization program has significant effects on output, employment and factor income.

Kimbrough (1983) develops a theoretical model and assesses the impact of unanticipated but permanent increase in money supply on output, price and exchange rate movements in the open economy. The study also utilizes flexible price and rational expectation aggregate supply function. The result indicates that unanticipated and permanent increase in domestic money supply may either overshoot or undershoot the exchange rate, but it depends on the relative magnitudes of income elasticity of spending on domestic output and income elasticity of demand for money and the responsiveness of trade account to change relative price levels. The model also explains that anticipated monetary shock does not cause deviation in the purchasing power parity as predicted by Wilson (1979).

Gerlach (1989) analyzes the impact of devaluation with the help of price stickiness and macroeconomic model. The study explains that devaluation under perfect flexible price improves the current account but not the trade balance. It also shows that the *J-curve*[12] arises under both mobility and perfect capital immobility conditions when relative price effect is small and demand for tradable goods is sufficiently sensitive to the real interest rate.

Thissen and Lensink (2001) analyze the macroeconomic effects of currency devaluation by developing computable general equilibrium (CGE) model for Egypt and incorporating financial markets along with forward-looking expectations. The authors conduct the calibration and dynamic simulation experiment over 1995-2007 data with both adaptive and forward-looking expectation. The results suggest that currency devaluation has

[12] The tendency of the trade balance to deteriorate immediately after devaluation and to improve only as time passes, Gerlach (1989).

strong effect on current account in the short run, whereas the strength of these effects becomes weak in the intermediate period for both adaptive and forward-looking expectations. The response of the production level for Egypt is negative under forward-looking expectations, while it is positive for adaptive expectation.

Bahmani-Oskooee and Miteza (2002) empirically estimate the relationship between nominal and real exchange rate for 19 LDC' economies over the period 1971:I to 1997:III. The study utilizes the real and nominal effective exchange rates in order to avoid the situation in which one country appreciates its currency and another depreciates. The findings based on ARDL and ECM indicates that in most cases, nominal as well as real devaluation is apparent both in short and long runs. Rahman *et al.* (2003) explore the association between real exchange rate and real trade balance for US and Japanese economies by using the quarterly data from 1973.I-1993.IV. The empirical findings suggest that there doesn't exist any long-run association between yen-dollar real exchange rate and US-Japan real trade balance. The study also notes the prominence of the bidirectional short-run Granger causality.

Gomez and Ortega (2005) employ the entropy to order approach of the real exchange rate for 28 developed and developing countries and claim that these rankings correlate with the intensity of economic growth in a currency crisis period. The study also mentions that low level of entropy for currency crisis leads to reduction in output growth. Batra and Beladi (2008) enlarge a new approach to currency depreciation namely "price approach" and evaluate the response of macroeconomic variables in response to currency

depreciation that has occurred in the emerging markets since 1997. Results with the help of theoretical model point out that currency depreciation is consistent with the spike in prices along with improvement in trade balance. The price approach also suggests that US devaluation is not helpful in the improvement of its trade balance due to low price level.

Table 2.1: Results of Contractionary Devaluation/ Depreciation

Study	Data/Period	Area of Analysis	Methodology	Results
Edwards (1986)	1965-1980	12 SSdeveloping countries.	Fixed effect procedure	Contractionary output in short-run but expansionary output after one year. However, this affect is neutral in long run.
Solimano (1986)		Chile economy		In short to medium run as 25% (percent) devaluation with fixed nominal wages and initial trade balance reduce the GNP by 3% (three percent) in the first two quarters.
Agenor (1991)	1978-87	23 countries	Rational expectations macro-model.	Anticipated depreciation is contractionary while unanticipated depreciation has expansionary effect on economic activity.
Kamin (1995)			Numerical simulation and output elasticities of macroeconomic model of black market for dollars.	Devaluation may call for less contraction in the occurrence of black market (exchange rate) than official market (exchange rate).
Iscan (1997)	Sector-wise data during 1970 to 1991.	Mexican economy	Random coefficient regression model.	Short-run contractionary effect of devaluation of non-agriculture sector and major contraction arises in case of manufacturing sector.
Upadhyay (1999 a)		"South Asia" and "South East Asia		Real and nominal devaluation almost fail to affect output growth and crowding out hypothesis is apparent.
Upadhyay & Upadhyay (1999b)		six Asian countries	Standard technique	Devaluation in general has a neutral effect on the economy in long run, while in short-run currency devaluation is positive in India and Philippines but negative in Pakistan.
ACAR (2000)	1970-1994	18 LDCs counties	Fixed effect procedure in panel estimation	Real depreciation is favorable for contractionary hypothesis in short-run, expansionary hypothesis in medium-run, and neutral in long-run.
Rajan & Shen (2001)	1981 to 1999	25 crisis affected Asian countries		Currency devaluation is expansionary during normal periods, while contractionary during crisis-periods.

Chou & Cho (2001)		Crisis affected Asian	Autoregressive distributive lag (ARDL) model.	Devaluation is contractionary in short-run but ineffective in long-run.
Miteza (2006)	Quarterly data set for 1993-2000.	Five transition economies	Panel unit-root test and panel cointegration.	Contractionary devaluation hypothesis for given five transition economies.
Kandil *et al.* (2007)	1980-2004.	Turkey	Three stage least square (3SLS)	Anticipated ER fluctuations reduce the output growth and unanticipated depreciation decreases the output, consumption and investment growth but increase the export growth.
Ratha *et al.* (2007)	1977-2006	China	Bounds-testing approach and ECM.	Overvaluation promotes growth in short-run.
Kalyoncu *et al.* (2008)		23 OECD countries		In long-run currency devaluation has a negative impact on output expansion in six countries and positive impact for three countries while in short-run currency depreciation is contractionary for three countries and expansionary for two countries.
Bahmani-oskooee & Kutan (2008)		Nine emerging economies of Eastern Europe.	Bounds testing approach to cointegration and ECM.	Real depreciation is expansionary in some countries while contractionary in other countries and have no effect in one out of nine countries.
Kandil (2008)	1960-2000	50 developing countries		Unanticipated depreciation due to the positive shock to the exchange rate increases the net export and money demand but decrease the output level.
Bahmani-oskooee & Kandil (2009)	1970-2004	MENA countries	Bounds testing approach to cointegration and ECM.	Unanticipated depreciation has no expansionary effect in the long run but Anticipated deprecation has a contractionary and expansionary effect on output.
Sencicek & Upadhyay (2010)	1970 to 2004	Turkey		Devaluation is contractionary in short run, expansionary in medium run and neutral in long run.

Table: 2.2 Results of Expansionary Devaluation/Depreciation

Study	Data/Period	Area of Analysis	Methodology	Results
Gylfason & Schmid (1983)		10 industrial and developing countries.	Estimate the structural parameters of the model.	Expansionary effect of devaluation appears in short to medium-run.
Anker & Bahmani-Oskooee (2001)	Quarterly data set over the period 1972-1996.		VAR along with appropriate cointegration vector.	Depreciation of Deutsche mark (DM) is expansionary in long-run.
Bahmani-Oskooee *et al*. (2002)	1976: I-1999: IV.	Selected Asian countries	Johnson cointegration	Output is expansionary for Philippines and Thailand while it reduces the output level for Indonesia and Malaysia.
Upadhyay *et al.* (2004)	1969 to 1998	Greece and Cyprus economy.	Conducting unit-root and cointegration test.	Depreciation is expansionary in short-run but neutral in medium and long-run.
Bebczuk *et al.* (2006)	1976-2003	56 industrial and developing countries	different form of panel modeling	With no external dollarization, 20% real devaluation increases the per capita GDP by half percentage point and contractionary devaluation emerges for the countries that have external dollarization greater than 0.84.
Narayan &Narayan (2007)	1970 to 2000	Fiji economy	Bounds testing approach to cointegration and ARDL.	10% devaluation increases the output by 2.3 and 3.3% in short and long-run, respectively.
Bahmani-Oskooee *et al.* (2008)	1975-1998.	29 LDCs countries	Panel cointegration, panel LS, LSDV, REM, and Maximum likelihood method.	Real depreciation of black market exchange rate is expansionary in LDCs.
Ratha (2010)	1970-2006.	Indian economy during	Bound testing approach to cointegration	nominal devaluation of rupee leads to real devaluation and currency devaluation is expansionary in India

Table: 2.3 Vector Autoregressive (VAR) findings:

Study	Data/Period	Area of Analysis	Methodology	Results
Rogers (2000)	1980:I to 1996:II.	Mexican economy	VARs analysis	Real devaluation is consistent with persistent high inflation and economic contraction.
Odusola & Akinlo (2001)	1970: I to 1995: IV.	Nigerian economy	Structural VAR	Contractionary impact of parallel exchange rate on output level.
Berument & Pasaogullari (2003)	Quarterly data from 1987: I to 2001: III.	Turkey	VAR model	Devaluation is contractionary, i.e. high price and low output.
De-Silva & Zhu (2004)		Sri-lankan economy	VAR and ECM	New exchange rate policy support to the improvements in trade balance and contractionary effect appears due to the continuous devaluation.
Kim &Ying (2007)	Quarterly data set	Seven East Asian countries and two Latin American countries.	Bivariate cross-correlation, causality test and VAR analysis.	East Asian economies have expansionary devaluation for the data set before the financial crisis. But the inclusion of post-crisis data leads to contractionary devaluation for East Asian economies.
Ramly & Abdel-Haleim (2008)	1982 to 2004	Egyptian economy	VAR model	Contractionary effect of devaluation last after four years before its expansionary effect works and variation in real exchange rate explain 45% to 68% changes in rate of growth of output.
Nishigaki (2007)	Monthly data from 1994 to 2006	East Asian economies	Structural VAR	East Asian currency appreciation escort to expansion in output and high united state (US) net export to East Asian.

Table 2.4 Theoretical Review findings.

Study	Approach	Results
Guitian (1976)	General equilibrium model	In long run, supply side determines the rate of growth of output and employment.
Hanson (1983)	Develops macroeconomic model of currency devaluation.	Possibility of substitution in consumption and production reduce the contractionary impact of currency devaluation and flexibility of wages also decreases its contractionary impact in labor market.
Burton (1983)	Small open economy model	Unanticipated devaluation has an expansionary effect on output while anticipated devaluation have contractionary impact on output.
Islam (1984)		Devaluation is consistent with high prices, short-fall in GNP and output in home goods sector and high trade deficit measured in domestic currency.
Barbone &Batiz (1987)	Short-run macroeconomic model	In short run, devaluation with rigid nominal wages, boost the price of home goods and redistribute the income from one class (wages) to other (Profit). For Jamaican economy, due to devaluation, larger negative effect happens on GNP in the presence of foreign capital.
Lizondo & Montiel (1989)	General analytical framework	On demand side, the impact of real devaluation depends on the condition of trade deficit and surplus as real income decline if deficit happen and vice versa.
Gylfason & Radetzki (1991)	Macroeconomic model of contractionary devaluation	Empirical simulations indicate that 10% devaluation improves the current account by 0.7% to 2.8% of GNP in the short to medium-run, or by 1.5% of GNP on average.
Ali & Scarth (1994)	Currency devaluation in the presence of Correspondence principle	Short-run analysis support to the Buffie's views, while in long-run, devaluation is neutral in response to the change in output and balance of payments.
Bird & Rajan (2004)	Theoretical model of exchange rate devaluation	Devaluation may contribute to capital outflows, loss of liquidity both directly and indirectly and result in contraction of output.

Chapter 3

ANALYTICAL FRAMEWORK

3.1. INTRODUCTION

This chapter provides the theoretical framework, analytical model and this study's contribution to empirical assessment. In this exercise the work of Krugman & Taylor (1978) has been followed to assess the response of real GDP to change in real exchange rate by employing the said authors' basic equations in open economy IS-LM framework. The logic behind using this model for analytical as well as theoretical purposes is that basically, this study for Pakistan is concerned with the absence or presence of contractionary devaluation hypothesis resulting from exchange rate convulsions in developing countries. Finally, the model is empirically estimated on the given framework in the next chapter.

3.2. A MACROECONOMIC MODEL

The macroeconomic model of an open economy is based on following assumptions:

(i) There are two sectors of goods market, the production of one is used for domestic demand and that of the other for exports.

(ii) Export and import prices are determined by foreign currency that is fixed, while mark up on direct cost of labor and imported input determines the price of home goods.

(iii) The wage rate is fixed by domestic currency.

(iv) The short run framework is utilized in which price fluctuation has no action on exports or imports. The given capacity decides the export volume while imports share a fixed coefficient with domestic production.

(v) In the given framework, only the income-expenditure relationship is considered due to the interest rate that is kept constant by the action of the central bank.

These assumptions are helpful in analysis and support the stylized uniqueness of many countries whose export earnings come from agriculture or mining sectors. The domestic industry depends on protective import substitution where a part of it is noncompetitive as intermediate goods and raw materials.

The equation of price for home goods is first taken up:

$$P_H = \left(a_{LH} w + a_{MH} P_M\right)(1+z) \qquad (3.1)$$

Where a_{LH}, a_{MH} stand for input coefficients of home goods for labor and imports respectively, w is the wage rate, P_M is home domestic price for imports, and z is a mark-up factor.

World prices, taxes, and the exchange rate settle the price of import and export, that is

$$P_X = e\left(1-t_X\right) \qquad (3.2)$$

$$P_M = e\left(1+t_X\right)P_M^* \qquad (3.3)$$

Where $e, t_X \text{ and } t_M$ stand for exchange rate of domestic currency for dollars, rates of ad-valorem tax on exports and imports, respectively. While P_X^*, P_M^* is the dollar price of exports and imports on world markets. From equation (3.1)-(3.3), it can easily be found that any change in the exchange rate causes change in traded goods prices relative to the wage rate and price of home goods and it is also unrelated to the terms of trade.

The income is divided between two classes, wage earners and profit or rental class. The following equations determine the nominal income of each class:

$$Y_W = (a_{LH}\, H + a_{LX}\, X)w \tag{3.4}$$

$$Y_R = z(a_{LH} w + a_{MH} P_M)H + (P_X - a_{LX} w)X \tag{3.5}$$

Where H and X stand for output of home goods and exports, while a_{LX} is the input of labor per unit of exports.

Another assumption for the validity of the proof is that all imports are input for home goods production as there is no direct final demand for imports. The given case implies that P_H is the proper deflator for the measurement of the real income of workers or capitalists. That is

$$\frac{Y_W}{P_H} = \frac{(a_{LH} H + a_{LX} X)w}{(a_{LH} w + a_{MH} P_M)(1+z)} \tag{3.6}$$

$$\frac{Y_R}{P_H} = \frac{z(a_{LH} w + a_{MH} P_M)H + (P_X - a_{LX} w)X}{(a_{LH} w + a_{MH} P_M)(1+z)} \tag{3.7}$$

We also assume the consumption function for the two groups, so the demand side of the model is written as:

$$H = C_W\left(Y_W / P_H\right) + C_R\left(Y_R / P_H\right) + I(r) + G \qquad (3.8)$$

$$M = a_{MH} H \qquad (3.9)$$

Here, M is real import, r is the interest rate that is assumed to be fixed, I and G stand for real investment and real government consumption. We also define for simplicity as under

$\partial C_W / \partial\left(Y_W / P_H\right) = \gamma_W$, $\partial C_R / \partial\left(Y_R / P_H\right) = \gamma_R$.

Under the fixed exchange rate system, the standard Keynesian open-economy model can be defined with equation (3.4)-(3.9). Now, the multiplier can be formalized both for home goods production and imports and the multiplier effect for government expenditure on both is:

$$\frac{dH}{dG} = \frac{1}{D}, \qquad \frac{dM}{dG} = \frac{a_{MH}}{D} \qquad (3.10)$$

However the effect of change in exchange rate can be analyzed in its place

3.3. INCOME EFFECTS OF DEVALUATION

In addition to the effect on the terms of trade, devaluations have some other possible income effects. Within the initial balanced trade account, devaluation redistributes income from the worker to the capitalist and from the private sector to government.

These channels of devaluation do not work independently but through interaction and it is impossible to decompose these effects separately. The special case of the model has been built in order to study the different income effects of devaluation individually.

3.3.1. Devaluation from an Initial Trade Imbalance

Hirschman (1949) and Cooper (1971) explain the situation with an initial trade deficit under which devaluation reduces the real national income and aggregate demand. Devaluation works through both by raising export and import prices. These higher prices are offset by each other if the trade is balanced and terms of trade are constant. The real income decreases within a country if its imports exceed exports.

The income loss can be quantified in the special case when there are no distributional $\gamma_R = \gamma_W = \gamma$, and fiscal effects $t_X = t_M = G = 0$. Algebraically, the elasticity of home goods output with respect to the exchange rate is:

$$\frac{dH}{de} \cdot \frac{e}{H} = K \cdot \frac{P_X X - P_M M}{P_H H}, \qquad (3.11)$$

Where, $K = (\gamma / D)(1 - (P_M M / P_H H)(1 + z))$.

From equation (3.1) and (3.7), it follows $P_M M(1+z) < P_H H$ that the result is in the positive value of K. The findings also indicate that whether it is the output of home goods, total output, employment, or rise or fall in imports it all depends on the condition of initial value of trade deficit or surplus. Hence, this condition implies that there usually is a contraction due to the devaluation in the deficit country. The extent of the given

percentage devaluation is proportional to the ratio of initial trade deficit to domestic production.

3.3.2. Distributional Effects

Devaluation redistributes income from wages to profit and rents class due to the rigidity of the nominal wage in the short-run and also due to the increase in the export receipts of domestic currency that generate a premium profit from the second term of equation (3.5). Devaluation may decrease the real wages due to the increase in the intermediate import cost. It is a fact that the marginal propensity to consume out of profit is smaller than the marginal propensity to consume out of wages; this hibernate effect will reduce the aggregate demand and import as mentioned by Diaz-Alejandro (1963).

The special case of the model when trade is initially balanced is here considered as $P_X^* X = P_M^* M$, (no trade balance effect) and also no fiscal policy as $t_X = t_M = G = 0$. Now, the solution for the elasticity of home goods output with respect to the exchange rate with some manipulation and assumption $\gamma_W > \gamma_R$ is that:

$$\frac{dH}{de} \cdot \frac{e}{H} = \frac{\gamma_R - \gamma_W}{D} \cdot \frac{Y_W}{Y} \cdot \frac{P_M M}{Y} \cdot (1+z), \qquad (3.12)$$

$Y = Y_W + Y_R$ is the total private income. The elasticity of output with respect to devaluation is proportional to the difference in marginal propensity to consume to the share of wages in income, and share of imports in income. The equality in consumption

propensities of each class implies that devaluation has no short-run effect on output, employment or trade but it just redistributes income from wages to profit.

3.3.3. Fiscal Effects of Devaluation

This part highlights the fiscal implication of devaluation that is more relevant. There are different possible channels through which it works, as the income effect of devaluation is initially caused by an imbalanced government budget. The share of income increases for government due to progressive income tax, or higher tax on profit than on wages. Ad valorem tax on export or imports increases the traded goods' price that redistributes income to the government.

In order to explain the deflationary devaluation, we consider an export tax and assume $t_M = 0,\ \gamma_R = \gamma_W = \gamma.$ It is also assumed that both the trade account and government budget are initially balanced, as $P_X^* X = P_M^*$ and $Y_W + Y_R = e P_X^* X + P_H H - e P_M^* M$.

The result for the given framework is that

$$\frac{dH}{de} . \frac{e}{H} = -t_X . \frac{1}{D} . \gamma . \left(P_M M / P_H H \right) \qquad (3.13)$$

The above equation indicates that devaluation elasticity is proportional to the tax rate on exports and the share of imports in income. The model employs the proportional tax function instead of marginal rate that is very high and more relevant. The fiscal drag from devaluation is strong due to selling farm exports to the state at a fixed price, as in the case of marginal tax rate.

3.3.4. Monetary Effects of Devaluation

The monetary approach to the balance of payments is another path through which contractionary effect of devaluation is caused. If the monetary authority keeps some monetary aggregate constant instead of pegging the interest rate, then the income effect of devaluation may become irrelevant. With the given output and employment, devaluation increases the price and demand for nominal money that results in contraction.

The contractionary effect on the monetary side is explained by developing an extreme quantity theory position that shows a strict proportional relationship between some monetary aggregates and income:

$$A = k\left(Y_W + Y_R\right) \qquad (3.14)$$

Where A is monetary aggregate fixed in short run. Using equations $(3.1) - (3.5)$ and (3.8), we derive the result as

$$\frac{dH}{de} \cdot \frac{e}{H} = -k\left(P_X X + \mathbf{z} P_M M\right)/\left(A - kP_X X\right) \qquad (3.15)$$

Thus the negative sign shows that devaluation is deflationary in the short run in monetarist as well as in Keynesian models.

3.4. MODEL SPECIFICATION

Following Krugman & Taylor (1978), the model is developed by deriving the IS-LM open economy framework through solving the above basic equations simultaneously and analyzing the effect of exchange rate on real output. This sub-section highlights the

contribution of this study in assessing the effect of devaluation/depreciation on real output level. The basic set up is followed as mentioned by equation (3.1) to (3.8) and derive the IS, LM and aggregate demand equations in an open economy that analyzes the response of real output due to change in real exchange rate. The demand side of the economy is explained by the following equation (3.8).

$$H = C_W\left(Y_W / P_H\right) + C_R\left(Y_R / P_H\right) + I(r) + G \qquad (3.16)$$

Where, C_W , C_R stand for the consumption of work and rental classes, respectively that depends on their own income. The study next takes up the work of Barbone & River-Batiz (1986) to write the real GDP equation in an open economy.

$$\frac{Y}{P_H} = H + Nx(e) \qquad (3.17)$$

Where, H is the demand for home goods as mentioned by equation (3.16).The substitution of equation (3.16) into (3.17) implies that

$$\frac{Y}{P_H} = C_W\left(Y_W / P_H\right) + C_R\left(Y_R / P_H\right) + I(r) + G + Nx(e) \qquad (3.18)$$

Where, C_W , C_R is the consumption of each class in the society and $\frac{Y}{P_H}$ is real GDP. The investment depends on real interest rate, while net exports depend on exchange rate. Investment, government expenditure and net exports are defined below as:

$$I = I_0 - br \qquad (3.19)$$

$$G = G_0 \qquad (3.20)$$

$$Nx = Nx_0 - ce \qquad (3.21)$$

$$M^d = k\left(\frac{Y}{P_H}\right) - fr \qquad (3.22)$$

Where, $b > 0,\ c > 0,\ f > 0, k > 0$

b , c, k and f stand for interest elasticity of investment, exchange rate elasticity of net export, interest elasticity of money demand and interest elasticity of money demand, respectively[13].

The equilibrium in money market is defined where real money balances are equated with real money demand.

$$\frac{M}{P} = M^d \qquad (3.23)$$

By replacing (3.22) into (3.23), and solving for LM-curve

$$\frac{M}{P} = k\left(\frac{Y}{P_H}\right) - fr \qquad (3.24)$$

[13] In order to solve the IS-LM open economy Mendel Fleming framework, we assume that monetary instrument "interest rate" is exogenous. i.e. there does not exist LM curve. Now, we have three endogenous and two exogenous variables that is desirable to solve the above system simultaneously.

After some manipulation, we obtain the LM-curve.

$$r = \left(\frac{k}{f}\right)\left(\frac{Y}{P_H}\right) - \left(\frac{1}{f}\right)\frac{M}{P} \qquad (3.25)$$

Equation (3.25) shows the different combination of interest rate and real income, where money market is in equilibrium. There exists a positive relation between real income $\left(\frac{Y}{P_H}\right)$ and real interest rate (r) that shows in an upward sloping LM-curve. In addition to that, its slope depends on interest elasticity of money demand (f).

In order to obtain the IS-curve in an open economy, we substitute equation (3.19)-(3.21) into (3.18).

$$\frac{Y}{P_H} = C_W\left(Y_W \big/ P_H\right) + C_R\left(Y_R \big/ P_H\right) + I_0 - br + G_0 + Nx_0 - ce \qquad (3.26)$$

Where, all variables are defined in real terms. Assuming that the 'law of one price' holds, the net export can be taken as a function of real exchange rate. In order to derive the IS-curve, equation (3.26) is simplified and the Krugman & Taylor (1978) model is followed that assumes the sum of wage and rental income equal to total income $Y = Y_W + Y_R$. In addition to that, it is also assumed that incomes of both classes are increasing function of total real income; in spite of that the increment may not be the same for each class and may lead to unequal distribution of income. The mathematical form of this assumption may be written as follows:

$$\frac{Y_W}{P_H} = f\left(\frac{Y}{P_H}\right) \qquad (3.27)$$

$$\frac{Y_R}{P_H} = f\left(\frac{Y}{P_H}\right) \qquad (3.27)'$$

By making use of equations $(3.27), (3.27')$, equation (3.26) can be written in the following form.

$$\frac{Y}{P_H} = C_W\left(Y/P_H\right) + C_R\left(Y/P_H\right) + I_0 - br + G_0 + Nx_0 - ce \qquad (3.28)$$

$$\frac{Y}{P_H}\left(1 - C_W - C_R\right) = I_0 - br + G_0 + Nx_0 - ce \qquad (3.29)$$

Now, we can derive the IS-curve in open economy such as:

$$\frac{Y}{P_H} = \frac{1}{\left(1 - C_W - C_R\right)}\left[I_0 - br + G_0 + Nx_0 - ce\right] \qquad (3.30)$$

Equation (3.30) shows the different combination of real income $\left(\frac{Y}{P_H}\right)$ and real interest rate (r), in which goods market is in equilibrium. In addition to that, the interest elasticity of investment (b) determines the slope of IS-curve.

Since the basic focus of this study is to evaluate the effects of changes in real exchange rate on real income, therefore, the aggregate demand equation is derived in open

economy and the effects are examined. Substituting equation (3.25) for equation (3.30) yields the following equation:

$$\frac{Y}{P_H} = \frac{1}{(1 - C_W - C_R)}\left[I_0 - b\left\{\left(\frac{k}{f}\right)\left(\frac{Y}{P_H}\right) - \left(\frac{1}{f}\right)\frac{M}{P}\right\} + G_0 + Nx_0 - ce \right] \qquad (3.31)$$

After some mathematical manipulations, the aggregate demand equation is derived as follows:

$$\frac{Y}{P_H} = \frac{1}{(1 - C_W - C_R) + \frac{bk}{f}}\left[I_0 + G_0 + Nx_0 - ce + \left(\frac{b}{f}\right)\frac{M}{P} \right] \qquad (3.32)$$

Equation (3.32) is the aggregate demand equation in the open economy that shows the different combination of price (real money balances) and real output. Now, in order to analyze the effect of exchange rate on real output, the derivative of real GDP is taken with respect to real exchange rate. The resulting outcome is given as follows:

$$\frac{d\left(Y/P_H\right)}{d(e)} = \frac{1}{(1 - C_W - C_R) + \frac{bk}{f}}[-c] \qquad (3.33)$$

$$\frac{d\left(Y/P_H\right)}{d(e)} < 0 \qquad (3.34)$$

The increase in real exchange rate leads to the reduction in real output in the long-run as indicated by equation (3.33) and (3.34). It is evident that both terms in the denominator on the left hand side of equation (3.33) are clearly positive as the sum of marginal propensities to consume of both classes must be less than one. In addition, the interest elasticity of investment (b), interest elasticity of money demand (f), income elasticity of

money demand (k) and the coefficient of real exchange rate (c) are also positive. This result is also consistent with Krugman & Taylor (1978).

Chapter 4

DATA, VARIABLES AND ECONOMETRIC METHODOLOGY

4.1. INTRODUCTION

This chapter explains the variables along with the nature, sources of data and econometric technique used in the study. It is divided into four main sections, where the first one considers the nature, type, sources and format of data. It also highlights the constituency and time period of analysis. The second section formulates the definition and the accurate concise description of different variables used in the underlying study. The third section conducts the Bivariate-data analysis by incorporating cross-correlation scrutiny and descriptive statistics of core variables while the last section is about the methodology or the explanation of the econometric technique employed to find empirical results.

4.2. DATA

For empirical analysis, the relationship between currency depreciation, output and price level in case of "Pakistan" is examined. It is selected for the reason that there has been a sudden shock to the exchange rate, especially with the arrival of the new century. In the developing countries like Pakistan, currency devaluation has been the major source of boosting exports and financing the balance of payments deficit. The specified framework also prompts to utilize the sample period for scrutiny from 1972 to 2010. The nature of this study requires times series analysis with total number of observation 39. After defining the brief overview of data set or description, there is a need to explain the source that is available to obtain the data set.

4.2.1. Data Source

The dependant set of explanatory variables is explained here with the variables' nature, source and format. The data source used for the dependent variables is the various issues of Economic Survey of Pakistan (ESP), whereas the data sources used for the explanatory variables are the Economic Survey of Pakistan (ESP), the "Handbook of Statistics on Pakistan Economy 2005","Fifty Years of Pakistan's Statistics Supplement", International Financial Statistics (IFS) and World Development Indicator (WDI).

4.3. VARIABLES

In this research study, different variables have been used for regression analysis and also for the theoretical extension of the model. This section defines the creation and the concise description of both dependent and explanatory variables.

a. Real output

The dependant variable used in the study is real output (real GDP) that is measured by the market value of final goods and services newly produced domestically. It is in constant domestic currency and measured in millions rupee with the base of 2000. The data source for "real output" is different issues of Economic Survey of Pakistan (ESP).

b. Government Expenditure to Real Income

One of the independent variables in empirical research is the ratio of government expenditure to constant GDP. Government expenditure comprises the total outlays on currently produced goods and services both at federal and provincial level, while real

GDP is the market value of domestically produced goods and services. This exercise follows Khan and Knight's (1981) work. It underlines that the level of fiscal expenditure is important in determining the aggregate production in developing countries but it is unambiguous with respect to their sign in altering the output level of the economy. The data series of government expenditure from 1972 to 1977 is extracted from "50 years of Pakistan Statistical Supplement" as this information is not found in the Economic Survey of Pakistan (ESP). It is calculated by excluding the capital expenditure of provinces and including the capital expenditure of the federal government that generate the sequential series.

c. Fiscal Deficit

Fiscal deficit is used to generate the series of main explanatory variable, i.e., "surprise money". It is defined as the excess of government outlays over revenue, where government outlays are government expenditure on government provision of goods at state and federal level, while government revenue is the collection of government income through tax or non-tax resources. The government expenditure in in excess over revenue and the budget deficit appears in continuous sequence for all time series in case of Pakistan (Various issues of Economic Survey of Pakistan). Some of ESP's missing values are derived from "50 years of Pakistan Statistical Supplement".

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d. Nominal Money

Nominal money is the main explanatory variable and defined by M2. The M2 monetary aggregate includes the narrowly defined official money measure M1 such as Currency,

Travelers' checks, Demand deposits, Cheque worthy deposits and other Time deposits. We follow the Khan and Knight (1981) formulation of insertion of monetary policy in determining the aggregate production and widen it by including the theory of rational expectation that substitutes the money supply term by money surprise or unexpected money growth formulation introduced by Edwards (1986). Money surprise is the fundamental variable of our empirical research and has effective impact on output in developing countries {Hanson (1980) and Edward (1983)}. The data set of M2 and M1 is extracted from ESP and International Financial Statistics (IFS), respectively.

The unexpected money growth term (money surprise term) $\left[\Delta \log M - \Delta \log M^*\right]$ is constructed by taking the difference between the actual money growth and the estimated rate of growth of money that is developed by money creation equation (4.1)[14] written as

$$\Delta \log M_t = a_0 + a_i \Delta \log M_{t-i} + a_j \, DEH_t + \varepsilon_t \qquad (4.1)$$

Where, i= 1- - - n, and n stands for desirable lags and j = 2.

M_t is M2 , $\Delta \log$ is logarithm along with first difference, M_{t-i} is desirable lag of M2, DEH_t is the ratio of fiscal deficit to lagged high powered money, a_0 is the intercept term, a_i is the desirable coefficient of lag of M2 , while a_j is the coefficient of fiscal deficit to lagged high powered money and ε_t is white noise error term with i.i.d process. In the given equation, the ratio of fiscal deficit to lagged high-powered money term is

[14] See, for example, Barro (1977), Hanson (1980) and Edwards (1983). Barro (1977) discusses the assumptions implicit in the use of residuals as proxies for money growth surprises.

used as an explanatory variable along with one lag of M2 based on the phenomena in developing countries where money creation is an important source of fiscal deficit financing [Edwards (1983)]. The equation (4.1) is estimated by applying log along with first-difference on both dependant and its lagged form as independent variables.

Here only one lag of M2 is followed. The inclusion of more than one lag does not (more) affect the estimated coefficient results {that are used to generate the equation (4.1)} but it reduces the level of significance of the underling variables. The inclusion in the study of just one lag also gives statistical significance to the results of coefficient of lagged M2 and budget deficit to lagged high powered money. However, budget deficit is an important variable in determining the money growth in developing countries (Khan & Knight, 1981). That is why, only one lag of M2 is introduced that improves the significant power of the estimated equation and gives reliable data series for unexpected money (surprise money). The entire diagnostic and stability test of the estimate equation (4.1) are reported in appendix A1. These tests are a guarantee that the results are reliable.

e. High Powered money

High powered money or monetary base is also employed in order to create a surprise money event. It is used in the analysis as a denominator of "fiscal deficit". The work of ACAR (2000) is followed here to calculate high powered money as:

$$Cash = M1 - DD \qquad (4.2)$$

Where,

$M1$ is narrow money that includes the currency in circulation, bank deposit and other deposits. DD is demand deposits

and

$$HPM = Cash + \text{Re}serve \qquad (4.3)$$

Where HPM is high powered money.

f. Terms of Trade

Terms of trade, an explanatory variable, is defined as the ratio of export price to import price, where the export price is the price of goods exported by home country to the rest of the world and import price is the price of goods imported by the domestic country from the rest of the world. Terms of trade are favorable for a country if its export price is higher than its import price or it has influential power in world market with respect to its external trade. It is used here as a device of international trade in determining the output level of the economy. The data set for "Terms of trade" is extracted from "Handbook of Statistics on Pakistan Economy 2005" published by State Bank of Pakistan (SBP).

g. Exchange Rate

Exchange rate is the main explanatory variable measured indirectly as local currency in terms of foreign currency. In order to calculate the real exchange rate, the relative price ratio of two countries is multiplied with the nominal exchange rate as

(Real exchange rate) = (Nominal exchange rate) × (Ratio of price levels)

$$\varepsilon = e \times \left(P / P^{*}\right) \qquad (4.4)$$

The real exchange rate is defined as the relative price of goods of two countries. It also gives the rate at which the goods of one country are traded with another country. $\left(P/P^{*}\right)$ is the ratio of domestic price to world price level, where domestic price (P) is explained by Consumer Price Index (CPI) that measures the current cost of a basket of consumer items divided by the same basket of consumer items in some base years and the world price level $\left(P^{*}\right)$ is mentioned by the consumer price index (CPI) of a world power, the United State of America (USA). In order to calculate the real exchange rate, the data for relative price ratio and nominal exchange rate is obtained from World Development Indicator (WDI).

In order to determine the response of dependant variable "real GDP" with the core explanatory variable "real exchange rate", bivariate data analysis is conducted that gives the dimension and response of "real GDP".

4.4. BIVARIATE DATA ANALYSIS

This section considers the descriptive statistics of the core variables such as real Gross Domestic Product (GDP) and real (nominal) exchange rate. In addition to that, in the second stage, by following Kamin & Rogers (2000), the reliability of the data is analyzed by evaluating Bivariate cross-correlations between Pakistan's real output (GDP) and the real exchange rate (the CPI-adjusted rupee price of US dollar) over the period 1972 to 2010. The results of descriptive statistics such as Mean, Median, Maximum, Minimum, Standard deviation, Skewness, Kurtosis are reported in table (4.1).

The table (4.1) below explains the results of descriptive statistics of the core variables such as Gross Domestic Product (GDP), real exchange rate and nominal exchange rate.

Table 4.1: Data Summary

	Gross Domestic Product (GDP)	Real Exchange Rate (RER)	Nominal Exchange Rate (NER)
Mean	2722134	31.78092	31.91996
Median	2517630	13.97246	23.80000
Maximum	5670768	148.8004	85.38000
Minimum	861431.7	1.477616	2.700000
Std. Dev.	1433472	35.77596	23.49613
Skewness	0.499411	1.436318	0.640077
Kurtosis	2.170910	4.639090	2.07456

After explaining the descriptive statistics of the core variables, the cross-correlation between real exchange rate and real output with various transformations is reported in table (4.2). The analysis takes into account leads and lags up to four periods, where lag denotes the number by which the real exchange rate is lagged relative to real GDP as indicated by the negative values; and lead denotes the periods by which real GDP is lagged relative to real exchange rate as indicated by the positive values.

The robustness, the sensitivity of cross-correlation and in particular, the disagreement on the equilibrium value of exchange rate inclines this study to exploit the different data transformations such as logarithmic form, first difference of logarithmic form, deviation

from linear, quadratic and cubic trends and the deviation from Hodrick-Prescott (H-P) Filtered trend. The given transformation analysis also helps to check whether the co-movements of real exchange rate and GDP run counter to each other or not i.e. if they are contractionary or expansionary in their effect.

Since the focus of this study is on evaluation of contractionary or expansionary effect of devaluation on output, it is interesting to note that the cross-correlation analysis with different transformations yields contradictory results as depicted by logarithmic form and

Table 4.2:Cross-correlations between the real gross domestic product (GDP) and real exchange rate with the sample period from 1972-2010.

Lags	Logarithmic Form	First Difference of Logarithmic Form	Deviation from Linear Trend	Deviation from Quadratic Trend	Deviation from Cubic Trend	HP Filtered	Deviation from the HP Filter Trend
-4	-1.06*	0.04	-0.08	2.39	1.21	-1.40***	-8.80***
-3	-0.96	0.08	0.15	2.34	0.93	-1.29***	-8.56***
-2	-0.93	0.08	-0.10	1.91	0.38	-1.18***	-8.19***
-1	-0.93*	-0.32	-0.69	1.20	-0.42	-1.07***	-7.88***
0	-0.91*	-0.16	-1.12	0.73	-0.85	-0.98***	-7.75***
1	-0.31	-0.27	-0.73	0.27	-0.92	-0.78**	-6.89***
2	0.40***	-0.00	-0.02	0.00	0.00	-0.59***	-6.21***
3	0.40***	0.00	-0.01	0.01	0.01	-0.41***	-5.55***
4	0.39***	0.00	-0.00	0.02	0.01	0.25*	-4.90***

Note: ***, **,* indicate the level of significance at 1%, 5%, and 10%, respectively.

H-P Filtered, while the deviation from H-P Filtered trend explains that real exchange rate is negatively correlated with real output. The positive values indicated by first difference of logarithmic form, and the different deviation trends indicate that there exists a positive relationship between real exchange rate and real GDP i.e., the appreciation of exchange rate is consistent with the reduction of output contrary to some empirical findings. But fortunately for empirical studies, the given contradiction remains statistically insignificant in four transformation cases. In three other transformations, it also becomes significant in both leading and lag years which indicates that real exchange rate is consistent with both increment and reduction in real GDP.

The logarithmic form of cross-correlation mentioned in the first column indicates mixed findings as negative and statistically significant correlation for the first and fourth lags period affirming the contractionary devaluation hypothesis. But the situation becomes reverse when we take leads instead of lags, indicating that statistically significant and positive phenomena works except in case of first period as real exchange rate is consistent with expansion in output, which is again in accordance with the theoretical position. However, in absolute terms its magnitude is highest in the fourth lag period.

Since, different transformations are employed due to disagreement about equilibrium values, the findings based on first difference of logarithmic form, deviations from linear, quadratic and cubic trends present a mixture of positive and negative correlation, but all of them remain insignificant. The given analysis proves a mix of contractionary and expansionary effects but with insignificant effect on the output level.

The results of H-P Filtered and deviation from H-P Filtered trend indicate statistically significant negative as well as positive cross-correlation between real exchange rate and real output for the Pakistan economy. The correlation is somewhat stronger with the fourth lag period in absolute terms indicating the validity of contractionary hypothesis. However, this also appears positive and significant in fourth lead period. The findings based on deviation from the H-P Filtered trend are again connected with contractionary devaluation i.e., appreciation is consistent with expansion in output and depreciation is consistent with contraction. The highest cross-correlation in absolute terms appears in fourth lag year; its magnitude is highest not only in comparison with its own leads and lags analysis but also with the cross-transformation analysis.

In sum it can be said that the findings based on different transformations indicate bias towards both reduction and increment in real GDP due to real depreciation. Based on transformation analysis of cross-correlation, what can be assessed is that both the leads and lags periods are more dominant for three out of seven transformation processes. This statement is based on the magnitude of cross-correlation and statistically significant results. After the brief description of data sources, variables and Bivariate data analysis such as cross-correlation and descriptive statistics, it is needed now to explain the econometric technique that is used to regress the econometric model for empirical scrutiny.

4.5. ECONOMETRIC METHODOLOGY

In order to regress the econometric model for empirical analysis, Khan and Knight (1981) who analyze the effects of stabilization programs on aggregate production in developing countries come handy. According to them, the existing disequilibrium in money market and the level of fiscal expenditure can affect the level of economic actions in these countries. Edward's (1986) input that extends Khan and Knight's (1981) views and replaces the excess money supply term with money surprise or unexpected money growth by using rational expectation framework has also been made use of. He also analyzes the role of devaluation and trade in assessing the real aggregate output by using the exchange rate (nominal and real) and terms of trade as explanatory variable.

Our estimated equations are as follows:

$$\log y_t = \alpha_1 + \gamma\, time + \beta_1 \log\left(GE/Y\right)_t + \beta_2 \left[\Delta \log M - \Delta \log M^*\right]_t + \beta_3 \log \tau_t + \beta_4 \log e_t + \varepsilon_{1t} \quad (4.7)$$

$$\log y_t = \alpha_2 + \gamma\, time + \beta_1 \log\left(GE/Y\right)_t + \beta_2 \left[\Delta \log M - \Delta \log M^*\right]_t + \beta_3 \log \tau_t + \beta_4 \log E_t + \beta_5 \log RPR_t + \varepsilon_{2t} \quad (4.8)$$

Where,

y = Aggregate real output

α_i = Intercept terms

γ = Capture the trend growth rate of output

$\left(GE/Y\right)$ = Ratio of government expenditure to real income

$\Delta \log M$ = Actual rate of growth of nominal money

$\Delta \log M^*$ = Expected rate of growth of nominal money

$\left[\Delta \log M - \Delta \log M^*\right]$ = Unexpected rate of growth of money (money surprise term)

τ = Terms of trade

e = Real exchange rate

E_t = Nominal exchange rate

RPR_t = Relative price ratio

ε_{it} = Error term $\quad i = 1 - - - - 2$

4.5.1. Stationarity of the Data and Cointegration

Since the aim here is to analyze the relationship among currency depreciation/devaluation, output and price level in case of Pakistan, different economic variables, other than the real exchange rate which is the main variable, based on past literature have been incorporated in this analysis that may influence the output level. Before analyzing the cointegration or existence of long-run relationship among the underlying series and to avoid spurious regression obtained by simply regressing the equation by ordinary least square (OLS) estimator, there is need to check the time series property of the data, i.e. stationarity of the data (unit-root test) for the underlying variables. According to the time series property, the non-stationarity of the variables may produce spurious regression results (Granger and Newbold, 1974). In order to capture that aspect, the unit-root test of the all time series variables is conducted that analyzes the core issue.

4.5.1.1. Unit-Root Test

In this part, the stationarity or non-stationarity of the data is analysed by conducting the unit-root test; but before that, it is crucial to understand the issue. The time series data is stationary, if the data generating stochastic process has the probability distribution of mean, variance and covariance, that is finite and independent of time, i.e. "time invariant". If the probability distribution of the data generating procedure has a time variant (time dependant) mean, variance or covariance, then the underlying variable has a unit-root problem, i.e. non-stationarity. Moreover, the absence of constant mean property suggests that the underlying series have the tendency to move away from the initial value over time. And it also becomes problematic for the econometrician when the non-stationary variable is regressed with other non-stationary variables that result in high value of R-squared along with causal relationship that instead of factual and fundamental relationship represents a contemporaneous spurious relationship. This analysis of stationarity is conducted by applying unit-root test.

The unit-root test can be conducted in the following way:

$$Y_t = \rho Y_{t-1} + u_t \qquad (4.9)$$

Where, u_t is a white noise error term and $-1 \leq \rho \leq 1$

The possibility of $\rho = 1$ generates the existence of unit-root problem. This is the example of random walk model without drift that is non-stationary. Equation (4.9) is used here as subtract Y_{t-1} from both side.

$$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + u_t \qquad (4.10a)$$

$$Y_t - Y_{t-1} = (\rho - 1)Y_{t-1} + u_t \qquad (4.10b)$$

or

$$\Delta Y_t = \delta Y_{t-1} + u_t \qquad (4.11)$$

Where, $\delta = (\rho - 1)$ and Δ is the lag or first-difference operator.

We estimate equation (4.9) and test the null hypothesis that $\delta = 0$, alternatively, $\rho = 1$ if the null hypothesis is accepted then the given variable is non-stationary, i.e., it has a unit-root. If δ is negative, then the underlying variable is stationary. Any non-stationary series can be made stationary by taking its difference, if we apply first-difference the given variable becomes stationary or is said to be *I(1)*. If its first-difference form is non-stationary, again applying its difference as difference of difference, then the series may become stationary or could be said to be integrated of order two *I(2)* and time series variable as $Z_t \approx I(d)$, if it requires d-difference. We employ Dickey and Fuller (1979) for Augmented Dickey-Fuller (ADF) test and Phillips (1987), Phillips & Perron (1988) for Phillips-Perron (PP) test to ensure the stationarity of the data series.

4.5.1.2. Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) Tests

In order to check the stationarity of the variables, we apply the augmented Dickey-Fuller (ADF) test. The modified form of Dickey-Fuller (DF) test known as ADF test takes the possibility of serial correlation in error term u_t that is independent and identically distributed (i.i.d) process explained by the DF test. The augmented Dickey-Fuller test

depends on the following regression equations (without intercept, with intercept and with intercept and trend).

$$\Delta Y_t = \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \qquad (4.12a)$$

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \qquad (4.12b)$$

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \qquad (4.12c)$$

Where, ε_t is white noise error-term and $\Delta Y_t = (Y_t - Y_{t-1})$. We test the null hypothesis that $\delta = 0$ and alternatively also follow the tau statistics for the estimated values of the coefficient that is just a Dickey-Fuller (DF) test in literature.

4.5.1.3. Phillips-Perron (PP) Test

The augmented Dickey-Fuller test takes the possibility of serial correlation in error term by incorporating lagged differences of the underlying variable. Phillip-Perron (PP) takes the possibility of serial correlation in the absence of lagged differences of the regressors or it takes fairly mild assumption concerning the distribution of the errors.

Basically, the concern here is with cointegration analysis for equation (4.7) and (4.8) that requires conducting unit-root test or stationarity of the data by applying the ADF and PP tests. If all of the variables under consideration are stationary at the same level i.e. integrated of order *I(1)*, application of the Johansen cointegration technique becomes a must. But the findings of unit-root test reported in the next chapter explain that all

variables are not stationary at the same level as (nominal) real exchange rate, government expenditure to real income and surprise money are integrated of the order zero *I(0),* while all others are integrated of the order one *I(1).* The different orders of stationarity for both the models in this study require that Johansen cointegration is not applicable here. However, the issue of non-stationarity of the same order is handled here by applying more advanced approaches like bounds-testing approach to cointegration or auto regressive distributive lag (ARDL) model developed by Pesaran *et al.* (2001).

4.5.2. Cointegration Analysis

In this sub-section, the cointegration technique is worked to establish the level relationship among the underlying series. The existence of relationship among the series may lead this work to further analysis such as normalized long-run estimates and short-run estimates of error-correction model. Firstly, the framework is extended by explaining the bounds-testing approach to cointegration.

4.5.2.1 . The Bounds Test Approach to Cointegration

In order to analyze the existence of long-run relationship among the variables, the bounds testing approach is applied to cointegration. For that purpose, we develop conditional error-correction model (CECM) that is useful as it does not require the unit root testing procedure and is applicable whether the variables are *I(0)* or *I(1)* or mixture of both series[15]. Narayan & Narayan (2007) explain that the bounds-testing approach to

[15] The given analysis is contrary to the other techniques such as Engle Granger (1987), Johansen and Juselius (1990) which have been developed for cointegration under the assumption that variables are integrated of same order i.e. stationary of same order. The second gain of this technique is that ARDL

cointegration is also applicable in small sample, whereas Engel and Granger (1987) and Johansen (1990) methods are not reliable for small sample[16]. The unrestricted error-correction models (UECM) are written as:

1: Real Exchange Rate to Output

The model that incorporates real exchange rate along with other explanatory variables based on equation (4.7) can be written as:

$$\Delta ly_t = \gamma\, time + \sum_{i=0}^{k} \beta_{1i}\, \Delta ly_{t-i} + \sum_{i=0}^{k} \beta_{2i}\, \Delta l\left(GE/Y\right)_{t-i} + \sum_{i=0}^{k} \beta_{3i}\, \Delta\left[\Delta lM - \Delta lM^*\right]_{t-i} + \sum_{i=0}^{k} \beta_{4i}\, \Delta l\tau_{t-i} + \sum_{i=0}^{k} \beta_{5i}\, \Delta l\, e_{t-i} + \delta_1\, ly_{t-1} + \delta_2\, l\left(GE/Y\right)_{t-1} + \delta_3\left[\Delta lM - \Delta lM^*\right]_{t-1} + \delta_4\, l\tau_{t-1} + \delta_5\, l\, e_{t-1} + \mu_t \qquad (4.13)$$

2: Nominal Exchange Rate to Output

Another form of the unrestricted error-correction model that takes nominal exchange rate along with relative price ratio as explanatory variables based on equation 4.8 can be written as:

$$\Delta ly_t = \gamma\, time + \sum_{i=0}^{k} \beta_{1i}\, \Delta ly_{t-i} + \sum_{i=0}^{k} \beta_{2i}\, \Delta l\left(GE/Y\right)_{t-i} + \sum_{i=0}^{k} \beta_{3i}\, \Delta\left[\Delta lM - \Delta lM^*\right]_{t-i} + \sum_{i=0}^{k} \beta_{4i}\, \Delta l\tau_{t-i} + \sum_{i=0}^{k} \beta_{5i}\, \Delta l\,\varepsilon_{t-i} + \sum_{i=0}^{k} \beta_{6i}\, \Delta l\, RPR_t + \Phi_1\, ly_{t-1} + \Phi_2\, l\left(GE/Y\right)_{t-1} + \Phi_3\left[\Delta lM - \Delta lM^*\right]_{t-1} + \Phi_4\, l\tau_{t-1} + \Phi_5\, l\,\varepsilon_{t-1} + \Phi_6\, l\, RPR_{t-1} + \nu_t \qquad (4.14)$$

---

model is drawn from the Unrestricted Error-Correction Model that has better statistical properties than other two approaches and does not drive the short-run dynamic into residual term. (Narayan & Narayan, 2007).

[16] Hakkio and Rush (1991) comment that cointegration being a long run concept requires a long span of data more than a large number of observations-so their sample of 25 annual observation was as good as 100 quarterly ones.

Where,

Δ is the first-difference operator. Residuals ν_t and μ_t are assumed to be normally distributed and white noise. In UECM, we use lagged values of log first-difference dependant variable Δly_t and log current and log first-difference lagged values of independent variables for short and long-run dynamics. The bounds-testing approach is applied for the presence of long-run relationship by applying Wald-coefficient test (F-statistics) or joint significance test on lagged-level variables in equation (4.13) and (4.14).

4.5.2.2. Joint Significance F-test

In this part, the joint significance test is conducted for the existence of long-run relationship among the series. The bonds-testing approach requires that all long-run variables are also defined as one period lagged level variables $\delta_i lx_{t-1}$ and $\Phi_i lx_{t-1}$ are jointly absent from the equation (4.13) and (4.14)[17]. The Wald-coefficient restrictions test is applied on lagged-level variables and compute F-statistics where the tabulated F-stat has two bounds, one is lower as *I(0)* and the other is upper bound *I(1)*. In order to determine the existence of long-run relationship among the variables, cointegration analysis requires that calculated F-stat is greater than the upper critical bounds tabulated in Pesaran *et al.* (2001). If the calculated F-stat lies below the lower bounds, then there doesn't exist any long-run relationship and the presence of calculated value of F-stat between two bounds leads to inconclusive results. The F-statistics have non-standard distribution and need to establish whether or not the variables are integrated of the order one or zero.

[17] This is also our null-hypothesis.

1: Real Exchange Rate to Output

The Wald-coefficient test is conducted on all lagged level variables that appear in equation (4.13). The test requires that the lagged coefficient of real output, government expenditure to real income, terms of trade, real exchange rate and surprise money are either absent from the equation or are equal to zero. If the null hypothesis is accepted than there doesn't exist any unique long-run relationship among the variables. The rejection of null hypothesis supports the idea of long-run relationship among the series.

The null and alternative hypothesis can be written as:

$H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$ (No cointegration or any relation)

$H_1 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 \neq 0$ (Cointegration exist)

2: Nominal Exchange Rate to Output

We also conduct Wald coefficient test on the lagged-level variables of equation (4.14). The test indicates that the coefficient of real output, government expenditure to real income, terms of trade, nominal exchange rate, relative price ratio and surprise money are not present in the equation or are equal to zero. The rejection of null hypothesis indicates that there exists a unique long-run relationship among the variables under consideration.

$H_0 : \Phi_1 = \Phi_2 = \Phi_3 = \Phi_4 = \Phi_5 = 0$ (No cointegration or any relation)

$H_1 : \Phi_1 = \Phi_2 = \Phi_3 = \Phi_4 = \Phi_5 \neq 0$ (Cointegration exist)

4.5.2.3. Choice of Lag Length

In order to apply the bounds testing approach to cointegration in ARDL framework, there is need of optimal lag-structure and the results of F-statistics are very sensitive to lag-length. We follow the Akiake Information Criteria (AIC) and Schwarz-Bayesian Criteria (SBC) to choose the optimal lag structure where, AIC select the maximum possible lag length, while the SBC is used to select the minimum possible lag-length.

4.5.3. Time Horizon and Dynamic Relation

After analyzing the stationarity of time series data and cointegration analysis, for the existence of long-run relationship among the related variables by using the ARDL approach developed by Pesaran *et al.* (2001), we analyze time horizon and dynamic relationship among the variables for both the models. Empirical findings for devaluation effect on output contradict for time horizon and different researchers arrive at different conclusions based on their size and region, for instance Sencicek & Upadhyaya (2010) and Edwards (1986) find that devaluation is contractionary in short-run, expansionary in the medium run and neutral in the long run for Turkish economy and a set of 12 developing countries. In contrast to that, Upadhyaya *et al.* (2004) evaluate that exchange rate depreciation is expansionary in short-run but neutral in medium and long-run in case of Greek and Cypriot economies{See also, Bahmani-Oskooee (2001) and Kandil (2008)}.

In the next sub-section, we estimate the long-run model.

4.5.3.1. Estimates of Long-run Autoregressive Distributive Lag (ARDL) Model

In this part, the long-run coefficient of the models presented in equation (4.13) and (4.14) is estimated. Since, our variable of interest is real exchange rate in the first model and nominal exchange rate along with relative price-ratio in the second that requires its size and sign in the long run. The long-run estimates are obtained by estimating equations (4.13) and (4.14) with OLS technique (bounds-testing approach to cointegration). Then, the resulting values are normalized by the coefficient of the lagged dependant variables. In this way, the mentioned simple simulation helps us to integrate the long-run coefficients. The ARDL approach for long-run coefficient can be written as:

$$ly_t = \gamma\, time + \sum_{i=0}^{k} \beta_{1i}\, ly_{t-i} + \sum_{i=0}^{k} \beta_{2i}\, l\left(GE/Y\right)_{t-i} + \sum_{i=0}^{k} \beta_{3i} \left[\Delta lM - \Delta lM^*\right]_{t-i} + \sum_{i=0}^{k} \beta_{4i}\, l\tau_{t-i} + \sum_{i=0}^{k} \beta_{5i}\, l\, e_{t-i} + \mu_{1t} \qquad (4.15)$$

$$ly_t = \gamma\, time + \sum_{i=0}^{k} \beta_{1i}\, ly_{t-i} + \sum_{i=0}^{k} \beta_{2i}\, l\left(GE/Y\right)_{t-i} + \sum_{i=0}^{k} \beta_{3i} \left[\Delta lM - \Delta lM^*\right]_{t-i} + \sum_{i=0}^{k} \beta_{4i}\, l\tau_{t-i} + \sum_{i=0}^{k} \beta_{5i}\, l\,\varepsilon_{t-i} + \mu_{2t} \qquad (4.16)$$

Where, the formats of all variables are the same as mentioned above.

4.5.3.2 . Short-run Error Correction Model of ARDL

In this part, the short-run error correction estimates of ARDL model are explained that give us the short-run coefficient along with the error-correction term. The error correction term is the difference between actual values minus estimated values that are obtained from bounds-testing approach mentioned as lag of dependant variable. It is the

adjustment coefficient that measures the disequilibrium from previous period or how much time it takes in the short run to move towards its equilibrium value in the long run. The error correction term should take negative coefficient along with statistically significant size that also measures the extent to which the correction of error takes place from short period to long period due to random shocks. The short-run error correction model can be written as:

1. Real exchange rate to Output

$$\Delta ly_t = \gamma\, time + EC_{t-1}\sum_{i=0}^{k}\beta_{1i}\,\Delta ly_{t-i} + \sum_{i=0}^{k}\beta_{2i}\,\Delta l\left(GE/Y\right)_{t-i} + \sum_{i=0}^{k}\beta_{3i}\,\Delta\left[\Delta lM - \Delta lM^{*}\right]_{t-i} + \sum_{i=0}^{k}\beta_{4i}\,\Delta l\tau_{t-i} + \sum_{i=0}^{k}\beta_{5i}\,\Delta l\, e_{t-i} + \mu_t \qquad (4.17)$$

2. Nominal exchange rate to Output

$$\Delta ly_t = \gamma\, time + EC_{t-1}\sum_{i=0}^{k}\beta_{1i}\,\Delta ly_{t-i} + \sum_{i=0}^{k}\beta_{2i}\,\Delta l\left(GE/Y\right)_{t-i} + \sum_{i=0}^{k}\beta_{3i}\,\Delta\left[\Delta lM - \Delta lM^{*}\right]_{t-i} + \sum_{i=0}^{k}\beta_{4i}\,\Delta l\tau_{t-i} + \sum_{i=0}^{k}\beta_{5i}\,\Delta l\,\varepsilon_{t-i} + \sum_{i=0}^{k}\beta_{6i}\,\Delta l\, RPR_t + \nu_t \qquad (4.18)$$

Where,

EC_{t-1} is lagged error-correction term.

4.5.3.3. Parameter Stability

The stability of parameters and models is important.. The instability of parameters of any model may mislead the econometrician as well as the policymaker. In addition to that, if the parameters of the models are not responsive to any reliable statistical significant outcome, it becomes problematic for the forecaster, whether it's the econometrician or

the policy analyst. Basically, we are concerned with time series data and its parameters may vary over a period of time. The misspecification of the parameters may lead to incorrect and biased conclusion about any issue. So, there is need to ensure the stability of estimated coefficients. Econometric constraints coerce us to utilize the ARDL approach along with error-correction mechanism in more than one model that requires the stability of ARDL parameters by conducting the diagnostic and stability tests.

First, the diagnostic test is conducted for all the models; whether it is bounds-testing approach to cointegration or short-run error correction mechanism. The diagnostics test covers the normality test, the white hetroskedasticity, the ARCH-LM test, the serial correlation LM-test and the Ramsey test for all of the models. There is also need to analyze the stability of the ARDL model as well as short-run coefficients of error-correction mechanism. For that purpose, we conduct CUSUM (cumulative sum of recursive residuals) and CUSUMQ (cumulative sum of recursive residuals of square) tests developed by Brown *et al.* (1975). These tests help us in assessing the parameters constancy of our types of models over time. The stability test depends on critical bounds at 5 per cent level of significance. If the plots of CUSUM and CUSUM-square do not diverge from the critical bounds, then the null hypothesis of correctly specified regression equations cannot be rejected and the underlying parameters of the model(s) is (are) stable. The application of stability test also required in ECM, where its lag coefficient measures the error in short run in order to attain long run equilibrium. If the CUSUM and CUSUMQ stability test lies in critical bounds, it further shows that the system is stable and also converges towards long-run equilibrium.

Chapter 5

ESTIMATION RESULTS AND INTERPRETATIONS

5.1. INTRODUCTION

The controversy of association among currency depreciation, output and price level has been an important debate in empirical literature. This controversy is analyzed here in the context of Pakistan by utilizing the yearly data series. For this purpose two sets of models are employed. The first one uses independent variables, real exchange rate, surprise money, government expenditure to real income ratio, and terms of trade. In the second the real exchange rate is replaced with nominal exchange rate and relative price ratio. This procedure may help in finding out the effect of price level on real output in case of Pakistan. In both models, the dependant variable is real output and the estimation is conducted by applying the autoregressive distributive lag (ARDL) approach due to the stationarity of the variables at different orders.

This chapter highlights and reports the empirical results and interpretations of both models. In the first section, unit-root tests are conducted that check the stationarity of the data series and confirm whether the variables under consideration are integrated of order zero *I(0)* or one *I(1)* or are a combination of both orders. The Augmented Dickey-Fuller (ADF) and Phillip-Parron (PP) tests are applied in section 5.2 and reported below. In the second section, the econometric models are tested as indicated by equation (4.13) and (4.14) by applying the bounds testing approach to cointegration. In addition to that, the

normalization of long-run elasticities and short-run error-correction estimates are elucidated and mentioned below.

5.2. UNIT-ROOT TEST

This section employs the results of unit-root test that has been performed by applying the two famed tests of stationarity i.e., the Augmented Dickey-Fuller (ADF) and Phillip-Parron (PP) tests. The theoretical underpinning or details about these tests have been explained already in the last chapter. Table 5.1 given below reports the results of the Augmented Dickey-Fuller (ADF) test for both dependant and independent variables. We apply the logarithm on all of the variables for estimation and stationarity and also constant or constant & trend for stationarity, wherever it is applicable or significant.

Table 5.1: Results of Unit Root Test (Augmented Dickey-Fuller Test: ADF)

Variables	Constant / Constant & Trend	Level	Ist-difference	Order of Integration
l ngdp	Constant	-2.47	-4.17***	*I(1)*
l ngery	Constant & Trend	-3.57**	-5.53***	*I(0)*
l nrer	Constant & Trend	-4.29***	-6.44***	*I(0)*
l nner	Constant & Trend	-5.27***	-6.67***	*I(0)*
l npp	Constant	-2.51	-3.41*	*I(1)*
l ntot	Constant & Trend	-2.42	-7.02***	*I(1)*
l nsmon	Constant & Trend	-7.10***	-3.36*	*I(0)*

Note: *, **, *** indicate the rejection of null hypothesis of unit-root at 10%, 5% and 1% level of significance, respectively. The Akaike Information Criteria is used to select the lag length (9 lags).

The real gross domestic product (GDP) is non-stationary at level along with the intercept term but it becomes stationary when we acquire its first difference as it rejects the null

hypothesis of non-stationarity at one percent level of significance. The ratio of government expenditure to real income is stationary at level along with constant & trend term and implying that it is integrated of order zero *I(0)*. The real exchange rate, nominal exchange rate and surprise money capture constant & trend and also stationary at level. However, the terms of trade and relative price ratio are not stationary at level but they becomes stationary at first difference, meaning that it is integrated of order one *I(1)*.

Table 5.2: Results of Unit Root Tests (Phillip-Parron Test: PP)

Variables	Constant / Constant & Trend	Level	Ist-difference	Order of Integration
l ngdp	Constant	-1.49	-4.14***	*I(1)*
l ngery	Constant & Trend	-3.33*	-5.50***	*I(0)*
l nrer	Constant & Trend	-4.36***	-15.10***	*I(0)*
l nner	Constant & Trend	-5.28***	-22.88***	*I(0)*
l npp	Constant	0.31	-2.62*	*I(1)*
l ntot	Constant & Trend	-2.44	-8.97***	*I(1)*
l nsmon	Constant & Trend	-7.04***	-22.15***	*I(0)*

Note: *, **, *** indicate the rejection of null hypothesis of unit-root at 10%, 5% and 1% level of significance, respectively.

Table 5.2 reports the results of the Phillip-Parron (PP) test. These results are almost similar to that of ADF test in respect of rejection or acceptance of null hypothesis of non-stationarity for all of the variables. Real GDP, terms of trade and relative price ratio are non-stationary at level as both variables accept the null hypothesis of unit-root but reject it at first-difference and are integrated of order one *I(1)*. Government expenditure to real income ratio, real exchange rate, nominal exchange rate, and surprise money take

constant & trend and do not have unit-root as they are stationary at level or integrated of order zero *I(0).*

Both the tests show that the order of integration of the underlying variables is not the same. The difference in same order of integration of variables requires the application of ARDL approach for the existence of long-run relationship among the series. The analysis as conducted is reported and explained in the following section.

5.3. RESULTS AND DISCUSSION

The results of estimation of the two models and discussion of logic used are explained in this section. In order to scrutinize the response of (real or nominal) exchange rate to output along with the combination of monetary, trade and fiscal variables, two models are estimated in both short and long-run by applying the ARDL approach. The tables given below explain the reaction of all explanatory variables such as real and nominal exchange rate, relative price ratio, and terms of trade, surprise money, and government expenditure to real income ratio.

5.3.1. Interpretation of Model 1

The results and interpretation of the model (4.13) in which dependant variable is real output and independent variable is real exchange rate along with the mixture of fiscal, monetary and trade variables are reported in table 5.3. The regression analysis follows 2 lags from the standard lag length selection criterion that is reported in appendix A2 for the regression of ARDL econometric model. In order to remove the highly insignificant

or less significant variables from the regression analysis, the general to specific rule is followed. This procedure may help in conducting the important property of ARDL approach that formulates the most appropriate or desirable regression analysis.

Table 5.3: Estimated Model 1:

Dependant	**Variable**	$\Delta \lg dp_t$		
Variable	**Coefficient**	**Standard Errors**	**t-Statistics**	**Probability**
$\Delta l\,gery_t$	-0.163955***	0.048446	-3.384322	0.0024
$\Delta lrer_{t-1}$	0.020061***	0.007347	2.730467	0.0114
$\Delta ltot_t$	0.036175	0.032851	1.101176	0.2813
$\Delta ltot_{t-1}$	0.104432***	0.036871	2.832333	0.0090
$\Delta lsmon_{t-1}$	-0.100790	0.064749	-1.556631	0.1321
$l\,gdp_{t-1}$	-0.025952**	0.012610	-2.058042	0.0502
$l\,gery_{t-1}$	-0.187961***	0.036875	-5.097275	0.0000
$lrer_{t-1}$	-0.035517***	0.008435	-4.210567	0.0003
$ltot_{t-1}$	-0.054397*	0.028635	-1.899687	0.0691
$lsmon_{t-1}$	-0.094877	0.119441	-0.794340	0.4345
$@trend$	0.018005***	0.003668	4.908575	0.0000
R^2	0.660993		**AIC**	-5.265957
Adjusted R^2	0.511831		**SBC**	-4.743497
D-W Stat	2.386811			

Note: ***, **,* denote the significance level at 1%, 5% and 10% level of significance, respectively. R^2, Adjusted R^2, D-W Stat, AIC, SBC stands for R-Squared, Adjusted R-Squared, Durbin-Watson Stat, Akaike information Criteria, and Schwarz Bayesian Criteria.

The given procedure in estimating equation (4.13) appears as the result of one or none of the lags of the dependant and explanatory variables in table (5.3). It captures all the lags that may have the desirable significance power in terms of statistical inference. But it does not mean that it may give us the (highly) significant result in terms of all variables, f some of which may be insignificant (as they may not have the significance power under the given policy framework). In addition to that, we are following the ideal of Khan and

Knight (1981) and its extension developed by Edwards (1986) that incorporates the time trend term in the analysis. The inclusion of time trend term and absence of intercept term from the estimation of equation (4.13) may enable us to obtain more desirable results that are closely related to policy analysis.

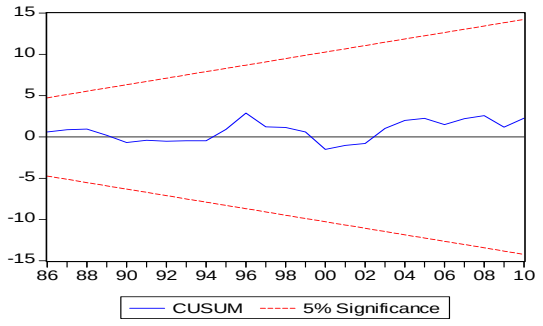
Since, the dependant variable is real GDP and its reaction along with the set of independent variables is mentioned above. The value of R-squared and adjusted R-squared is 0.66 and 0.51, respectively that shows 66 percent variation in the determination of real output which is explained by the model. The value of Durbin-Watson statistics is 2.38 that satisfies the desirable level and validates the rejection of null hypothesis of serial autocorrelation at any order. The unique model selection or information criteria mentioned by Akiake Information Criteria (AIC) and Schwarz Criteria is (-5.265) and (-4.743), respectively.

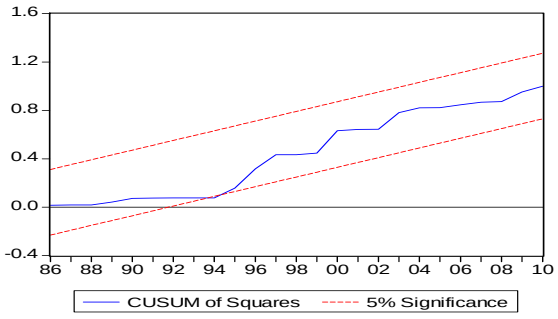
All diagnostic and stability tests such as hetroskedasticity, normality, serial correlation, autoregressive conditional hetroskedasticity (ARCH) and functional-form misspecification (Ramsey Regression Specification Error Test) are reported in table (5.4). The report of real output to real exchange rate generally passes all diagnostic tests. For the normality test, the Jeque-Bera statistics are reported that take non-normal errors; its value is 1.55 along with the probability value of 0.45; it also indicates the presence of normal distribution. The null hypothesis of hetroskedasticity is rejected with the probability value 0.68 that supports the evidence of no hetroskedasticity across the terms.

Table 5.4: Diagnostic and Stability Test of Estimated Model 1:

	F-Statistics	Probability
χ^2_{NORM}	1.554623	0.459640
χ^2_{WHITE}	0.807778	0.684886
χ^2_{RAMSEY}	0.521209	0.477302
χ^2_{ARCH}	0.153253	0.697888
$\chi^2_{Serial\,Corr}$	1.341892	0.281055

Note: For normality test, we report Jeque-Bera statistics. $\chi^2_{NORM}, \chi^2_{WHITE}, \chi^2_{RAMSEY}, \chi^2_{ARCH}, \chi^2_{Serial\,Corr}$ are non-normal errors normality test, white hetroskedasticity test, Ramsey Regression Specification Error Test, and Auto regressive Conditional Hetroskedasticity (ARCH Test), Serial correlation Lagrange Multiplier Test (LM-type Breusch-Godfrey-Test). These statistics are distributed as Chi-square values and explain the degree of freedom at last column.





This also does not furnish the evidence of serial autocorrelation that supports the idea of no autocorrelation across the terms. The autoregressive conditional hetroskedasticity (ARCH) test is also according to the desirable level. The Ramsey test indicates that the result is in favor of stability of parameters.

The plotting of CUSUM and CUSUM-square statistics of estimated equation (4.13) are in critical bounds and do not diverge from that critical region that specifies the stability of the coefficient in the estimated model. They also confirm the stability of long and short-run estimates of the model from real exchange rate to real output in ARDL estimation.

The absence of divergence and presence of convergence mainly support the long-run as well as the short-run stability of the model, in particular the long-run estimates that just require the normalization process.

The test for the presence of cointegration or long-run relationship among the series requires the application of the Bounds testing approach in which all long-run coefficients are restricted/ tested with the equality of zero[18]. The result of the Wald-coefficient test is reported in table 5.5. It records the value of F-statistics is 10.26 with the probability value 0.000 and indicates the rejection of null-hypothesis of no-cointegration at zero percent level of significance. The critical values of F-statistics with different level of significance and along with lower and upper bounds are also reported in table 5.5. In addition, the calculated value lies above the upper *I(1)*critical value of F-statistics, indicating the evidence of cointegration or long-run relationship among the series.

Table 5.5: Bounds Testing Approach

	F-statistics	**Probability**
	10.26469***	0.0000

Critical Values of F-statistics

Significant Level	**Lower *I(0)***	**Upper *I(1)***
1%	3.50	4.63
2.5%	3.11	4.13
5%	2.81	3.76
10%	2.49	3.38

Source: Pesaran *et.al* (2001).
Note: *** denotes the significance at 1% level of significance and rejection of null-hypothesis of no cointegration.

[18] It is Wald-coefficient test in econometrics software language and comprehensive knowledge about the bounds-testing approach and Wald-coefficient test have been explained already in chapter 4.

After determining the existence of long-run relationship among the series by applying the bounds testing approach, there is a need to define the long-run coefficients of ARDL estimation. The long-run coefficients are derived by normalization process in which the cointegration vector term[19] multiplied by minus (mentioned in table 5.3) is divided by all long-run explanatory variables. The derived results that reflect the reaction of real output to the series of explanatory variables along with "real exchange rate" are reported in table (5.6).

Before considering the theoretical justification of the normalized long-run estimates of ARDL model, there is need to explain some theoretical and empirical aspects about the previous studies. On theoretical ground, currency depreciation leads to increase in net exports that may result in expansion of output [Dornbush (1988), Keynesian (1931)]. On empirical side, some studies [Upadhyay & Upadhyay (1999), Miteza (2006), and Kalyoncu *et al.* (2008)] follow the expansionary output hypothesis that is consistent with the theoretical literature. The short-run results of this study are in line with that of the theoretical and empirical literature. However, on the empirical side, a great deal of literature is also available that is not consistent with theoretical literature and indicates that currency depreciation may result in reduction of output [Berument & Pasaogullari (2003), and De-Silva & Zhu (2004)]. As mentioned above in table 5.6, currency depreciation is connected with reduction in output in the long run. In order to defend the contractionary framework in the long run, the demand or supply side channels are explained that have real balancing, redistribution and inelastic import price effects as well as the cost of imported inputs and wage inflation channels, respectively.

[19] It is also the lag of dependant variable in equation 4.14.

Table 5.6: Normalized Long-run Estimates of ARDL Model 1

Regressors	Coefficients
$lrer_{t-1}$	-1.36857***
$ltot_{t-1}$	-2.09606*
$l\,gery_{t-1}$	-7.24264***
$lsmon_{t-1}$	-3.65586

Note: ***,* denote the significance level at 1% and 10% level of significance, respectively.

The model is estimated in double-log form with the calculating coefficient values of "real exchange rate" -1.368 (mentioned in above table 5.6). It is significant at one percent level of significance indicating that one percentage point increase in real exchange rate may cause 1.36 percentage point reduction in output in the long run. Our long run estimates of real exchange rate may chase the contraction in output and are contrary to the theoretical literature but strongly supported by empirical studies such as Kandil (2008).

Since Pakistan is a developing country, currency depreciation has been an important source of augmenting exports and foreign exchange reserves. But in empirical literature there is a controversy regarding the exchange rate channel viz a viz output and currency depreciation that may result in loss of output (in the long run). Its sign or effect may be expansionary as validated by the theoretical as well as the analysis of this study (in short-run) due to the immediate effect of currency depreciation on output. But in case of Pakistan, this immediate effect may disappear in the long run due to political instability that has persisted all through the data period under consideration and may capture the effects of trade restrictions in the form of quota and import duties imposed by international donors or the World Trade Organization (WTO). These restrictions together

with soaring oil and oil-based products' prices or different channels of demand and supply side, mentioned below, may increase net exports in the long run, that would ultimately result in the contraction of output.

In order to explain the contractionary depreciation hypothesis, the demand and supply side channels are explained with respect to Pakistan. The real balance effect that arises from the demand side, explains that the depreciation of domestic currency may increase the general price level due to high price of tradable products as compared to non trade-able products. These higher prices may decrease the real balance $\left(M/P\right)$ of the economy and this effect may become severe if the high proportion of consumption depends on trade-able products.

In case of Pakistan, the high proportion of consumption depends on trade-able products seen in the high imports and trade deficit (Economic Survey of Pakistan, 2010) and it may severely affect the real balance of the economy. But the classical system of perfect information along with flexible prices validate that output achieves equilibrium in the long run and the real balance channel is not valid under flexible price system. However, this is also true in case of Pakistan where there is no evidence of price rigidness. In that case, output may move towards its long-run value and the contractionary shock in output may disappear due to the loss in real balance term. In this way, the real balance effect is not applicable in case of Pakistan.

The income redistribution effect from the demand side explains that there are different classes of consumers in a given society [Diaz-Alejandro (1963), Krugman & Taylor (1978)]. In most of the LDCs, Pakistan in particular, these classes consist of profit makers and wage earners among whom the latter have high Marginal Propensity to Consume (MPC) as compared to the former. This is because the working class in Pakistan has minimum access to the most suitable and desirable jobs and also has limited access to saving opportunities[20].

The depreciation of domestic currency increases the price of trade-able products that may result in high relative income of profit earners. In addition to that, in LDCs, there is wage rigidity and the rise in prices due to depreciation may result in fall of real wages $\left(W/P\right)$. This process may increase the profits' share and decrease the wages' share in national income. As a result, aggregate demand shrinks and output contracts in the long run.

The contractionary depreciation framework can also follow from income redistribution that may occur due to transfer of income from private to public sector. In LDCs, particularly Pakistan, there are ad valorem tariffs on both exports and imports; depreciation of domestic currency may increase the value of both exportable and importable products. In the long run, this process may increase the overall amount of tax revenue and transfer income from private to public sector. In sum, private expenditure may diminish due to low amount of disposable income and the existence of high MPC for

[20] "Those living closer to the margin of subsistence are likely to have little savings and even less scope for borrowing, so their marginal propensity to consume is likely to be very close to one. This is why redistribution effects are likely to be large in LDCs" (Caves, Frankel and Jones, p.477).

the private sector than the public sector[21]. These factors result from the reduction in aggregate demand and may support contractionary depreciation hypothesis in the long run [Krugman & Taylor (1978)].

Most of the LDCs have an excess of external debt stock and bear large amount of interest on it. The accumulated debt burden in case of Pakistan is 8,160 billion rupees or 55.6 percent of GDP along with 473.5 billion rupees in interest payments or 3.2 percent of GDP at the end of March 2010 (Pakistan Economic Survey, 2010). In Pakistan, most of the external debt appears in (US) dollar terms or any other strong currency. Devaluation or depreciation of domestic currency may raise the burden on both the local residents and governments due to the loss in value of domestic currency against the currency in which debt is denominated; and they need to have more local currency in order to pay that outstanding debt. Both the private and public sector may face deterioration in their net wealth due to the depreciation of domestic currency and this has been the routine trend in the current political situation of Pakistan[22].

The severity of the deterioration in net wealth may largely depend on the amount of external debt stock and (high) interest burden on it. [The external debt in case of Pakistan was 3,669 billion rupees along with 45.0 billion rupees in interest payment or 0.3 percent of GDP. It has been increasing since 2005, when it was just 1,856 billion rupees or 28.5 percent of GDP (Pakistan Economic survey, 2010)].The increase in the amount of

[21] "Devaluation redistributes income from the private sector to the government, which has a saving propensity of unity in the short run", (Krugman and Taylor, p.446)

[22] 148 billion rupee out of the total public debt is attributed due to the depreciation of national currency against the dollar during July 2009-March 2010 as Pak rupee lost 4.2 percent of its value (Pakistan Economic survey, 2010).

external debt stock in the long run may compel the debtors to decrease their expenditure due to the negative windfall in net wealth. This effect may result in contractionary shift of aggregate demand and result in reduction in national income. In case of Pakistan the combination of large amount of external debt burden along with high interest on it and routine depreciation of the rupee may cause this channel to work more properly.

Another channel, through which output of the economy may decrease, is removal of import restrictions. In Pakistan, due to the overall aim of developing the domestic production level, a number of restrictions have been placed on foreign trade, including, rarely, import quotas. But the support of international agencies like the International Monetary Fund (IMF) and the World Bank is conditional on economic discipline and opening the economy through liberal policies. They want imposition of trade liberalization rules and removal of import quotas. Devaluation is proposed as another option to promote exports or to restrict imports.

Trade liberalization along with depreciation of domestic currency may increase imports in the short run[23]which may negatively affect domestic output levels. This has been a common feature and has hurt large scale industries like automobile manufacturing which could not compete with imported models.[24] Under these circumstances, output level of

[23] Depreciation/devaluation of domestic currency and increment in import appear from the *J-curve*: in which net export suddenly falls in short-run due to deprecation of domestic currency.

[24] For Pakistan, increase in its import from 183.4 to 221.0 for textile machinery, 379.7 to 579.2 for Aircrafts Ships and Boats, 78.1 to 180.0 for agriculture machinery and 4612.4 to 5305.3 million dollar for petroleum products and its percentage share of world export has decreased from 8% to 0% for automotive products, 4% to 0% for telecommunication equipment, 4% to 0% for pharmaceuticals, 18% to 5% for fuels from 2008 to 2009 and especially (Pakistan Economic Survey, 2010).

the economy tends to follow the contractionary pattern with the depreciation of the currency.

In Pakistan, the financial markets are not developed enough and any speculative behavior may result in the loss of domestic assets or production. Fear of depreciation of domestic currency any time in the near future under the present unstable political situation can induce people to invest in physical assets due to non-availability of protective tools such as bonds and securities. This may increase expenditure in the short run though a contractionary effect may appear in the long run when the domestic currency is devalued. This contractionary effect will owe much to the loss suffered in assets already purchased and non-availability of financial facilities. The combination of different effects or channels that arise from demand side explains that currency depreciation is contractionary in the long run in case of Pakistan.

In spite of the abundance of demand side channels, there are few supply side channels that may accompany contraction in output due to depreciation of domestic currency in the long run. Devaluation or depreciation is consistent with the higher prices of traded goods and ultimately the higher general price level. That may result in reduction in real wages $\left(W/P\right)$ and loss of the purchasing power of the working class that may demand increase in nominal wages which is only possible if there is a flexible wage system. Since such a system does not prevail in Pakistan, the low wage structure would be of no help in saving the loss in domestic production. In fact it may even result in consumption losses due to the depressed purchasing power of the wage earning class.

Another possibility is the wage indexation mechanism[25] that saves the loss in production from workers' side. But this process may increase the cost of production through higher wages and depress the output level from the producer side. Moreover the wage indexation channel has not been working properly in LDCs, particularly in Pakistan (Bilquees, 2006). In most of the LDCs, the demand for higher wages is not accepted and may result in worker strikes and resultant loss of production or contraction in output level. In this way, currency depreciation may follow the application of wage indexation mechanism and exert a contractionary effect on output level.

The import of raw material, intermediate or capital goods, particularly oil and such other materials has been the common factor of weakness of LDC economies. Pakistan is a major importer of oil, spending US$ 5305.3 million on petroleum products and US$ 1055.2 million dollar on import of edible oil (Soybean & palm oil) in 2010 (Pakistan Economic survey, 2010). The depreciation of domestic currency increases the cost of imports and import –based domestic manufactures [Krugman & Taylor (1978), Edwards (1986), and Van Wijnbergen (1986)]. This process may decrease the import of required input materials due to high cost that results in low production and reduction in output supply.

This effect has been evident in Pakistan where production of major goods depends on imported oil. Due to the higher prices of energy and other inputs, the cost of production

[25] Wage indexation is a system in which wages and interest are tied to the cost-of-living index in order to reduce the effects of inflation.

increases resulting in production losses and high unemployment in the economy[26]. In this way, depreciation of domestic currency manifests as a negative effect on output and employment and at the same time loss in the production level.

The final channel of supply side through which contraction in output occurs is the cost of working capital. It is assumed that in the standard economic theory model, capital is fixed in the short run while other factors of production such as labor cost, intermediate input and raw materials are variable. In developed financial market systems there is no hindrance in obtaining short-term funds. On the other hand, in Pakistan the financial markets are not well established and obtaining loans is troublesome. Such limitations make working capital as another variable factor of production. In addition to that, depreciation of domestic currency may squeeze the volume of available credit along with high interest cost on it [Van Wijnbergen (1986)]. This increases the cost of production and decreases fund availability. It shows that depreciation of domestic currency is associated with reduction in output level of the economy[27].

The combination of demand side and supply side channels mentioned above indicates that all channels require relatively long span of time in order to work more properly. It can only happen in the long run. , Where the time span is too short the different possible channels fail to be effective, particularly under productive conditions prevailing in

[26] This is apparent from the high oil prices in 1970s and 1980s, due to many LDCs countries suffered in loss of production and high unemployment.

[27] In supply side channel, high interest cost is similar to the real balance channel mentioned in demand side channels. As depreciation may pushes the price above and result in reduction in real money balance $\left(M/P\right)$. That may decrease the volume of credit and increase the interest rate.

Pakistan. However, its short-run sign may be positive as currency depreciation is expansionary in the traditional open economy macroeconomic model. The reduction in output may follow all of the above channels or the combination of some or any of them. These results are also shown by Cooper (1971), Gylfason & Radetzki (1985) and Bird & Rajan (2004).

The terms of trade is another explanatory variable that is negatively related with the output level in the long run with the coefficient value -2.096 and also statistically significant in case of Pakistan. It indicates that one percent increase in the terms of trade leads to 2.09 percentage point reduction in output level of the economy. The logical explanation of its sign can be explained by the fact that the major part of Pakistan's economy is dependent on imports[28] and its import price has been increasing over time due to global inflation and the depreciation of the Pak rupee. Since the beginning of the new Century its import price has been rising over its export price and this upward trend in import price is prominent due to high price of energy, raw materials, petroleum products or capital goods[29].

The excess of import price over export price since 2000 along with the high import cost of inputs following the separation of East Pakistan has made the import bill proportionally higher and the excess of import bill or volume of imports over exports has had a negative effect on net exports that may cause a contractionary shift in the IS-curve

[28] The historical data of Pakistan shows that its export has been less than its imports: see graph in appendix A3.
[29] The historical chart or graph of import price and export price since new century is shown in appendix A4.1.

in the IS-LM framework and this contractionary shift in the IS-curve may decrease the output level of the economy.

On the other side, Pakistan's export price has been higher than its import price since the year 2000[30]. Higher export price means higher income for the exporters who may increase their consumption of luxury products that are mostly imported. This may lead to increase in imports even surpassing the quantum of exports bringing about the contractionary shift of IS-schedule and reduction in output level of the economy. Moreover, the exporters of Pakistan belong to the rich class of society which with their low MPC compared to the poor class only consume a small proportion of their income and may thus cause a contractionary shock to the aggregate demand from the consumption side. In this way, the terms of trade is negatively consistent with the output level of the economy in the long run, which is consistent with the empirical findings.

We also employ the monetary framework to determine the output level in an open economy environment along with the explanatory variable of "surprise money". Its calculation method has been mentioned in the previous chapter. In our analysis, it is negatively related with the output level of the economy along with the coefficient value of 3.655, but statistically, it is highly insignificant in case of Pakistan, indicating that no surprise shock of the central bank will influence or disturb the output level of the economy.

[30] The historical chart or graph of imports price and exports price during 1972 to 2000 are shown in appendix A4.2.

In order to capture the effect of fiscal policy, following Edwards (1986) the "ratio of government expenditure to real income" is incorporated. It is a vital determinant of real income in developed as well as in developing countries but, in our framework, it is negatively related with the output level with the coefficient value of -7.242 that is also highly significant at one percent level of significance. It indicates that one percentage point increase in the ratio of government expenditure to real income may result in 7.242 percentage point reduction in output of the economy in the long run.

In an open economy framework, the increase in government spending may cause an inward shift in the savings curve. In contrast to a closed economy, in an open economy, the equilibrium interest rate is determined where the domestic interest rate is equal to world (foreign) interest rate. The inward shift in the savings schedule may call for high domestic interest rate as compared to world interest rate. Since, the domestic interest rate is higher than the world interest rate or vice versa, it may require the inflow of capital from the world economy to the domestic economy (where interest rate is higher) and result in high demand for domestic currency or supply of foreign currency.

Historically, in case of Pakistan the inflow of capital due to high interest rate has been less than expectations. This is due to political instability and on account of deterioration of capital.. The inflow of capital is small due to that stipulation which also affects the demand and supply framework of the foreign exchange market. It may result in the increase in demand of domestic currency and outward shift in demand schedule. This may cause the exchange rate to increase resulting in appreciation of the Pak rupee against

the world currency. The appreciation of the rupee raises the cost of domestically produced goods and decreases the price of foreign goods resulting in higher imports or cut in net exports. In IS-LM framework, the loss in net exports may cause decline in output level.

It is also apparent that investment is a function of interest rate and expected profitability. In an open economy framework, the increase in government expenditure may result in higher domestic interest rate over and above the world interest rate that would be attractive for foreign investors. But in a weak political situation with soaring oil prices eating into the economy, and high capital cost the expected profitability of investment would not materialize. This downturn in expected profitability may scare the prospective foreign investor and result in left-ward shift in the investment schedule ultimately affecting the crowding-out framework or reduction in output [Upadhyay (1999)].

In spite of the rationale explained above, it is clear from the historical data that Pakistan's government spending on non-development side has been higher as compared to development side[31]. High non-development expenditure does not raise the output level which in Pakistan's case has had a diminishing trend.

Moreover, government can finance its spending from different sources such as by increasing taxes (indirect or direct), borrowing from public, borrowing from the central bank, and borrowing from international agencies. Borrowing from the central bank in

[31] Appendix A5, shows the graph of government expenditure on development and non-development side, that clearly explain the picture.

developing countries is an important source to finance spending and amounts to an inflation tax[32] but it may reduce the purchasing power of the people and result in less consumption as well as aggregate demand. Borrowing from external resources has also been on the increase typically from international agencies like the World Bank and the, International Monetary Fund (IMF). And these borrowings have been made under unpleasant conditions such as high interest rate and high inflation in the domestic economy. This has caused a contractionary shift in aggregate demand in the presence of high government spending. All of these factors combine to exert a contractionary effect on the aggregate output level of the economy in the long run. In this way, government spending is seen to be negatively related to output.

After the interpretation of the long-run normalized estimates of the ARDL model, we may evaluate and interpret its short-run error-correction estimates.. These are obtained by developing the data of error-correction term which is the difference between actual and estimated values. The model is then estimated by applying the least square (LS) method along with all desirable lags. The short-run coefficient of error-correction estimates, reported in table (5.7) is the same as the estimation of the combination of all short and long-run estimates of the ARDL model in table (5.5). However, the difference must be shown in terms of the coefficient of error-correction with its significance level. At the time of individual estimation of the short-run estimates in table (5.7), its significance level along with other variables may become better statistically.

[32] Pakistan borrowing from central bank and other sources has been explained in table appeared in appendix A6.

The error-correction term is the same as the cointegration vector in the long run and it also indicates the speed of adjustment in which the variables move to long-run equilibrium in the dynamic model after or within one year, depending on lag values. The error-correction term must be negative and statistically significant since it is (-0.05) and (-7.39) respectively, that is highly significant at zero percent level of significance. The negative value of the coefficient (-0.05) explain that in short period almost 5 per cent adjustment may take place to gain the equilibrium in the long run and it also explains the deviation of exchange rate in the long run or the change in real exchange rate is corrected by 5 per cent each year. However, it also indicates that the adjustment takes place at a low level.

Table 5.7: Short-run Error Correction Estimates of Model 1

Variable	Coefficient	Standard Errors	t-Statistics	Probability
$\Delta l\,gery_t$	-0.158546***	0.042701	-3.712965	0.0009
$\Delta lrer_{t-1}$	0.020436***	0.006214	3.288480	0.0026
$\Delta ltot_t$	0.039618	0.028535	1.388393	0.1756
$\Delta ltot_{t-1}$	0.119585***	0.025459	4.697622	0.0001
$\Delta lsmon_{t-1}$	-0.046648	0.041151	-1.133579	0.2663
EC_{t-1}	-0.059139***	0.007997	-7.395377	0.0000
$@trend$	0.017779***	0.002335	7.612502	0.0000
R^2	0.641374	**AIC**	-5.425911	
Adjusted R^2	0.554809	**SBC**	-5.077605	
D-W Stat	2.3010381	**L-L**	108.3794	

Note: *** denotes the significance level at 1% level of significance. R^2, Adjusted R^2, D-W Stat, AIC, SBC, L-L stands for R-Squared, Adjusted R-Squared , Durbin-Watson Stat, Akaike information Criteria, Schwarz Bayesian Criteria, and Log-likelihood of equation.

The overall performance of the model is good as mentioned by R-squared and Adjusted R-squared values that are 0.64 and 0.55 respectively. The value of Durbin-Watson

statistics is 2.30 that is near to the desirable level with no problem of autocorrelation in the estimated model. The model information criteria is mentioned by AIC, and SBC that have the most high and desirable values such as 5.42 and 5.07 respectively in absolute terms, indicating that maximum information is captured by these criteria.

Our main explanatory variable, "real exchange rate" has an expected sign and it is positively related to the output level in the short run, consistent with the classical or traditional theory of open economy such as the Dornbusch open-economy macroeconomics model or the Keynesian open-economy macroeconomics framework. Its coefficient value is 0.02 and at one percent (1%) level of high significance. It indicates that one percentage point increase in exchange rate or depreciation of domestic currency may lead to 0.02 percentage point increase in output level of the economy.

The logical way to interpret it would be to track the traditional model or the theory of Dornbusch's or Keynes' for the open economy. The depreciation of Pak rupee may lead to high price of imported goods and low price of domestic product in the short run. The low price of domestic product may attract the foreigner to import from the domestic economy. Higher exports along with low imports of the country may increase the net export level of the economy in the short run and also result in expansionary shift of IS-schedule in the Keynesian open-economy framework. This overwhelming effect may cause an increase in output as per the expansionary hypothesis of exchange rate evaluation. However, in the short run this theory is applicable and has a strong and determining effect but in the long run other channels that have been mentioned above in

detail are likely to work and invalidate the expansion in output. These results are also consistent with [Upadhyay *et al.* (2004), and Narayan &Narayan (2007)].

Another explanatory variable in our research framework is the terms of trade which has an expected sign and is positively related to the output level of the economy in the short run. The coefficient value of the terms of trade is 0.11, that is also statistically highly significant at one percent level of significance. It mentions that one percentage point increase in terms of trade may increase the output level by 0.11 percentage point. The increase in terms of trade means that this variable is favorable for the country. The terms of trade may improve due to short period boom in exported goods or short period incentive provided by international community. Such a boom may increase the price of exported products but it tends to disappear in the long run when the import price increases. This trend has been most common in case of Pakistan, where any good news at the time of political instability increases the price of exported goods in the short run. These results are also consistent with the [Sencicek and Upadhyay (2010), Hernandez (2011].

For the monetary framework, we take the idea of Khan and Knight (1981) and its extension developed by Edwards (1986) that incorporates surprise money as monetary variable to determine the output level of the economy. The coefficient value of surprise money is (-)0.04 and indicates that one percent increase in surprise money may lead to (-)0.04 percentage point reduction in the output level of the economy but it is

insignificant in case of Pakistan, meaning any surprise monetary shock has no significant effect on the output level.

We also include the fiscal variable in our analysis that is the ratio of "government expenditure to real income". This is an important variable that may positively affect the output level of the economy. But in this analysis, it is negatively related to the output level and has a coefficient value of (-)0.15, that is highly significant, indicating that one percent increase in government expenditure to real income ratio may decrease the output level by 0.15 percentage point in the short run. However, this effect becomes strong in the long-run as already explained.

The results of this study strongly support the classical theory of output determination, in which, increase in government spending results in reduction in output level through the crowding out phenomena. The short-run implication of negative sign in government spending is the same as of the above channels in the long-run. However, the coefficient value in the short span of time is very small, indicating that the above channels despite their weak influence may still cause reduction in output level. Its sign is easy to determine from the government's excess spending on the non-development side that may result in output loss. It is for this reason that government spending is negatively related to output level in case of Pakistan [Upadhyay (1999)].

The diagnostic and stability tests of short-run error correction estimates are explained in table 5.8. The diagnostic and stability test such as hetroskedasticity, normality, serial

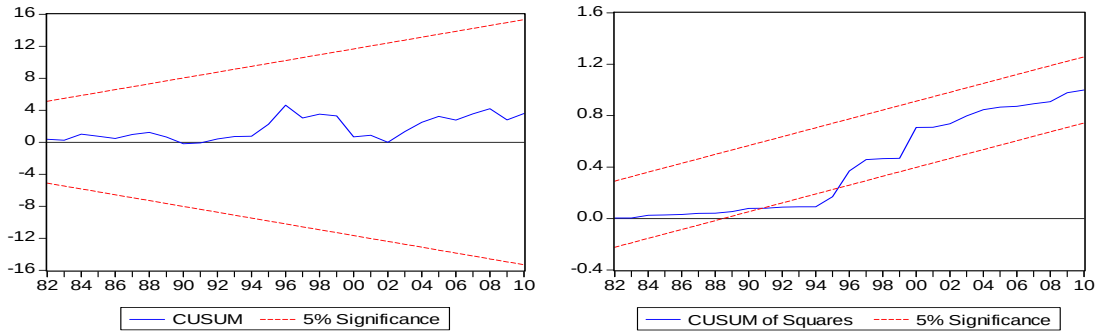
correlation, ARCH test and functional-form misspecification (Ramsey Regression Specification Error Test) have been reported above. The response of real output to real exchange rate in the short run is tested along with error-correction term that generally passes all diagnostic tests. In order to conduct the normality test, the Jeque-Bera statistics that take non-normal errors, are reported; its value comes to 1.66 along with probability value of 0.43. The null hypothesis of hetroskedasticity is also rejected with 0.51 probability value. It shows the absence of hetroskedasticity across the terms. The null-hypothesis of serial autocorrelation is also rejected indicating that there is no problem of autocorrelation. The value of Ramsey test is 0.22 which indicates that the result is in favor of stability of the parameters.

Table 5.8: Diagnostic and Stability Test of Short-run Error Correction of Model 1:

	F-Statistics	**Probability**
χ^2_{NORM}	1.668081	0.434291
χ^2_{WHITE}	0.977810	0.511539
χ^2_{RAMSEY}	0.220284	0.642458
$\chi^2_{ARCH-LM}$	0.158947	0.692621
$\chi^2_{Serial\,Corr}$	0.686506	0.511903

Note: For normality test, we report Jeque-Bera statistics.

$\chi^2_{NORM}, \chi^2_{WHITE}, \chi^2_{RAMSEY}, \chi^2_{ARCH}, \chi^2_{Serial\,Corr}$ are non-normal errors normality test, white hetroskedasticity test, Ramsey Regression Specification Error Test, and Auto regressive Conditional Hetroskedasticity (ARCH Test), Serial correlation Lagrange Multiplier Test (LM-type Breusch-Godfrey-Test). These statistics are distributed as Chi-square values and capture degree of freedom on first-right column.



The plotting of CUSUM is in critical bounds, showing that the short-run coefficient does not diverge and captures the stability in the estimated model. However, the CUSUM-square statistics is not in critical bounds and it may diverge from that critical region that indicates instability of the coefficient in the estimated model. It also indicates that the real exchange rate and output may not converge to their mean value in the short run and open economy policies or international policies may be changed in order to incorporate stability in the analysis.

5.3.2. Interpretation of Model 2:

This sub-section explains and interprets the results of model 2 as mentioned in equation (4.14) by using the ARDL approach. In this model, we replace the independent variable "real exchange rate" with the "nominal exchange rate" along with the relative price ratio. Table 5.9 below reports the findings of the equation (4.14) by following 2 lags[33] along with the application of general to specific rule that excludes the highly insignificant or less significant variables from the estimated ARDL model. This process may not only improve the significance of the model but also help us to improve the information criteria

[33] The lag-length for the estimation of equation (4.14) is followed by the standard lag-length criterion that is explained in appendix 1F.

as mentioned by AIC and SBC criteria. In the final estimation, we include the time trend term and exclude the intercept term that makes our results more desirable. In addition to that, the time trend variable is significant in the estimated model which is also helpful in making other variables more desirable and significant.

Table 5.9: Estimated Model 2:

Dependant	**Variable**	Δly_t		
Variable	**Coefficient**	**Standard Errors**	**t-Statistics**	**Probability**
$\Delta l\,gery_t$	-0.176330***	0.058095	-3.035215	0.0059
$\Delta l\,ner_{t-1}$	0.018542**	0.009082	2.041546	0.0528
$\Delta lrpr_{t-1}$	0.069921	0.078385	0.892023	0.3816
$\Delta ltot_t$	0.037162	0.034550	1.075619	0.2933
$\Delta ltot_{t-1}$	0.105810***	0.041054	2.577300	0.0168
$\Delta lsmon_{t-1}$	-0.106818	0.069503	-1.536888	0.1380
ly_{t-1}	-0.028417**	0.013509	-2.103499	0.0466
$l\,gery_{t-1}$	-0.193311***	0.041591	-4.647964	0.0001
$l\,ner_{t-1}$	-0.033935***	0.013327	-2.546301	0.0180
$lrpr_{t-1}$	-0.047862	0.038805	-1.232467	0.2302
$ltot_{t-1}$	-0.055162*	0.029590	-1.864236	0.0751
$lsmon_{t-1}$	-0.093784	0.138210	-0.678563	0.5042
$@trend$	0.018858	0.004033	4.676318	0.0001
R^2	0.667952	**Adjusted R^2**	0.480272	
AIC	-5.178588	**D-W Stat**	2.396619	
SBC	-4.569051			

Note: ***, **,* denote the significance level at 1%, 5% and 10% level of significance, respectively. R^2, Adjusted R^2, D-W Stat, AIC, SBC stands for R-Squared, Adjusted R-Squared, Durbin-Watson Stat, Akaike information Criteria, and Schwarz Bayesian Criteria.

The performance of the estimated equation is good as mentioned by the R-squared and adjusted R-squared values that are 0.66 and 0.48, respectively. The value of Durbin-Watson statistics is 2.39 and it is closer to the standard level, indicating the absence of

auto-correlation at any lag. The model selection criteria is mentioned by AIC and SBC that are (-5.17) and (-4.56), respectively. The cointegration vector term is negative and statistically highly significant evaluating the convergence of all explanatory variables to their mean value in the long run.

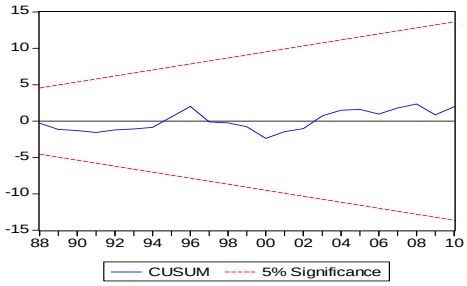
Table (5.10) reports the results of the diagnostic and stability test of estimation of equation (4.14) that requires the application of ARDL model. The diagnostic test as mentioned by normality test takes non-normal errors; its value is 0.71 along with probability value of 0.69. It indicates the presence of normality in the estimated model. There is no evidence of hetroskedasticity across the term that is apparent from the probability value of 0.18. The diagnostic test also appeals to the absence of serial correlation as mentioned by the probability value of 0.20. The functional-form misspecification (Ramsey Regression Specification Error Test) test is also in favor of stability of parameters of both short and long run.

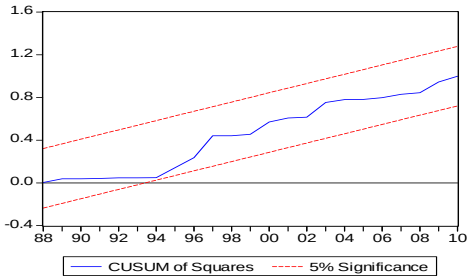
Table 5.10: Diagnostic and Stability Test of Estimated Model 2:

	F-Statistics	**Probability**
χ^2_{NORM}	0.714579	0.699570
χ^2_{WHITE}	1.844529	0.185342
χ^2_{RAMSEY}	0.061701	0.806131
$\chi^2_{ARCH-LM}$	0.197274	0.659744
$\chi^2_{Serial\,Corr}$	1.704479	0.206080

Note: For normality test, we report Jeque-Bera statistics.

χ^2_{NORM}, χ^2_{WHITE}, χ^2_{RAMSEY}, χ^2_{ARCH}, $\chi^2_{Serial\,Corr}$ are non-normal errors normality test, white hetroskedasticity test, Ramsey Regression Specification Error Test, and Auto regressive Conditional Hetroskedasticity (ARCH Test), Serial correlation Lagrange Multiplier Test (LM-type Breusch-Godfrey-Test). These statistics are distributed as Chi-square values and capture degree of freedom on first-right column.





The stability test in the sense of CUSUM and CUSUM-square as plotted above shows the stability and movement of all variables towards dynamic equilibrium both in short and long-run. The value of statistics of both the tests are in critical bounds and do not diverge from that path. The convergence in stability term of the model nominal exchange rate to output indicates that the coefficients of all the variables are stable implying their long-run equilibrium.

Table 11: Bounds testing Approach

	F-statistics	**Probability**
	8.114162	0.0001
Critical Values of F-statistics		
Significant Level	**Lower *I(0)***	**Upper *I(1)***
1%	3.27	4.39
2.5%	2.90	3.94
5%	2.63	3.62
10%	2.33	3.25

Note: *** denotes the significance at 1% level of significance and rejection of null-hypothesis of no cointegration.

In order to analyze the existence of long-run relationship among the series, we conduct the bounds testing approach to cointegration. In that technique, the coefficients of all long-run variables are adjusted or restricted to zero as explained by null and alternative hypotheses mentioned in section 4.5.2.2. The resulting value of F-statistics indicates the

rejection of null hypothesis of no cointegration at the zero percent level of significance. Its value is 8.11 with the probability value of 0.001. Since this value of F-statistics lies above the upper level *I(1)* with the one percent level of significance that declares the presence of cointegration among the series in the long run.

After developing the long-run relationship among the series, the normalized long-run values of ARDL model are estimated. The long-run estimates are established as all the long-run coefficients divided by the cointegration vector multiplied by minus sign. The resulting long- run coefficients have been reported in table (5.12) that is almost similar to the model where the independent variable is the real exchange rate instead of nominal exchange rate, along with the relative price ratio.

Table 5.12: Long-run Estimates of Autoregressive Distributive Lag (ARDL) Model 2.

Regressors	Coefficients
$l\,gery_{t-1}$	-6.80265***
$l\,ner_{t-1}$	-1.19418***
$l\,rpr_{t-1}$	-1.68301
$ltot_{t-1}$	-1.94116*
$lsmon_{t-1}$	-3.30028

Note: ***,* denote the significance level at 1% and 10% level of significance, respectively.

The nominal exchange rate is negatively related with the output level of the economy in the long run. Its coefficient value is (-)1.19 indicating that one percent increase in nominal exchange rate may lead to 1.19 percentage point reduction in output level in case of Pakistan. The coefficient value of nominal exchange rate is almost the same (with a

minor difference) as the value of real exchange rate, reported in the above model. But here the nominal exchange rate represents the price of two currencies, instead of the relative price of goods of two countries.

The value of nominal exchange rate or nominal depreciation follows the same channel as mentioned above to determine the contractionary output level of the economy in the long run. Both the demand side channels as the income redistribution, real balance, import cost, taxation, external debt, and trade liberalization and, from the supply side, the imported input cost, cost of working capital and wage indexation channels, support our results. These channels have been mentioned already in detail. With these channels, the nominal depreciation may lead to the contraction in output level of the economy. These results have firm support of Kalyoncu *et al.* (2008).

Another dependant variable in our analysis is the relative price ratio; it has been incorporated by excluding the real exchange rate and including the nominal exchange rate. It is negatively related to the output level of the economy but it has been insignificant both in the short and long run. Its coefficient value is (-)1.68, indicating that one percent increase in the relative price ratio leads to 1.68 percentage point reduction in the output level of the economy. The insignificance of relative price ratio explains that the given variable does not have any effect on the output level of the economy. In other words, there is a one-to-one relationship between the real exchange rate and nominal exchange rate or that nominal depreciation leads to real depreciation. The role of prices is

ineffective in determining the output level of the economy. The results derived here have the strong support of Sencicek & Upadhyaya (2010).

In order to capture the effect of monetary policy, we include surprise money as an independent variable. This variable has an expected sign but it is insignificant in case of Pakistan in the long run as its coefficient value is (-3.30) indicating that one percentage increase in surprise money shock leads to 3.30 percentage point reduction in output level of the economy. These results are contrary to the statement of Khan and Knight (1981) s that monetary variables are important in determining the output level of the economy in developing countries.

In our research analysis, we also include the terms of trade as explanatory variable along with other variables. Terms of trade is negatively related with the output level in case of Pakistan along with coefficient value of (-1.94) that is significant at 10 percent level of significance, indicating that one percent increase in terms of trade leads to 1.94 percentage point reduction in output level of the economy. The logical interpretation of its sign is the same as mentioned above for model 1. In this way, the terms of trade factor may decrease the output level of the economy.

In fiscal policy analysis, we employ the important economic variable of the ratio of "government expenditure to real income". It has an expected sign in the long run as negatively related with the output level. Its coefficient value at (-6.80) indicates that one percent increase in government expenditure to real income ratio may lead to 6.80

percentage point reduction in output level of the economy. Our results strongly support the classical theory of crowding out, in which increase in government expenditure may lead to reduction in output. In addition to that, there are a number of factors that may cause fall in aggregate demand in the presence of high government spending as mentioned above, while interpreting the long-run estimates of model 1 in table (5.6).

Table 5.13: Short-run Error Correction Estimates of Model 2.

Variable	Coefficient	Standard Errors	t-Statistics	Probability
$\Delta l\,gery_t$	-0.172763***	0.047023	-3.673989	0.0010
$\Delta l\,ner_{t-1}$	0.018835***	0.006225	3.025573	0.0053
$\Delta lrpr_{t-1}$	0.076830	0.066117	1.162044	0.2550
$\Delta ltot_t$	0.040603	0.028721	1.413710	0.1685
$\Delta ltot_{t-1}$	0.121212***	0.025939	4.673042	0.0001
$\Delta lsmon_{t-1}$	-0.053651	0.041555	-1.291077	0.2072
EC_{t-1}	-0.064812***	0.008776	-7.384988	0.0000
trend	0.018633***	0.002454	7.592114	0.0000
R^2	0.648921	**Adjusted R^2**	0.548612	
AIC	-5.393126	**D-W Stat**	2.288749	
SBC	-5.001281			

Note: *** denotes the significance level at 1% level of significance. R^2, Adjusted R^2, D-W Stat, AIC, SBC stands for R-Squared, Adjusted R-Squared, Durbin-Watson Stat, Akaike information Criteria, and Schwarz Bayesian Criteria.

Table (5.13) above reports the results of short-run error correction estimates for all the variables by conducting one period lag and current period values of equation (4.14) as mentioned in table (5.9). The error correction term is negative and statistically highly significant, along with coefficient value of (-)0.06, indicating that in the short run all variables move to long run equilibrium with slow adjustment, that is only 6 per cent per year. The presence of the significant trend term and the absence of intercept may offer us

highly desirable results that are closer to policy implication. The value of R-squared at 0.64 means that 64 percent variation in nominal exchange rate along with price ratio is explained by our model. The value of Durbin-Watson test and the model information criteria mentioned by AIC and SBC are well defined.

In the short run, nominal exchange rate is positively related to the output level of Pakistan, the same as in case of real exchange rate. Its coefficient value at 0.01 means that one percent increase in nominal exchange rate may give us 0.01 percentage point increase in real output of Pakistan. The nominal depreciation or increase in exchange rate in the short-run may lead to reduction in the price of exported goods or increase in the price of imported products. The fall in export prices may attract the foreign buyer to order more imports that may increase the net exports of the country and aggregate demand of the economy. In this way, currency depreciation in nominal terms may lead to increase in output level of the economy in the short run.

The sign of relative price ratio is positive with the coefficient value of 0.07 means that one percent increase in relative price ratio may contribute to 0.07 percent increase in output level for Pakistan. But its insignificance in case of Pakistan strongly supports the evidence that nominal exchange rate and real exchange rate have a one-to-one relationship. The increase in output arises from nominal to real exchange rate, not from relative price ratio [Sencicek and Upadhyaya (2010)].

The terms of trade is another explanatory variable and has the same reaction as in the previous model in the short run. It is positively related to the output and has a coefficient value 0.12, indicating that one percent increase in terms of trade may give us 0.12 percentage point increase in output in case of Pakistan. The positive sign in terms of trade means that it is favorable for a developing country as it has been for Pakistan in the short run due to the positive windfall in the economy.

Surprise money has been used as an explanatory variable to define the monetary framework. It is negatively related in the given framework though insignificant in the given model in short run. The insignificance of surprise money mainly supports the classical economy in which any surprise event of central bank remains unable to affect the output level of the economy.

The fiscal side has been an important determinant of the output level of any economy. But in case of Pakistan, in the short run, it is negatively related to the output level along with the coefficient value of (-)0.17, meaning that one percent increase in government expenditure to real income ratio may cause to reduce the output level of the economy by 0.17 percentage point. This is due to the crowding out and overspending on non-development side. This would imply that government spending is negatively related to output in case of Pakistan.

All diagnostic and stability tests of short-run error correction model have been reported above in table (5.14). The normality test for error term, white hetroskedasticity test for

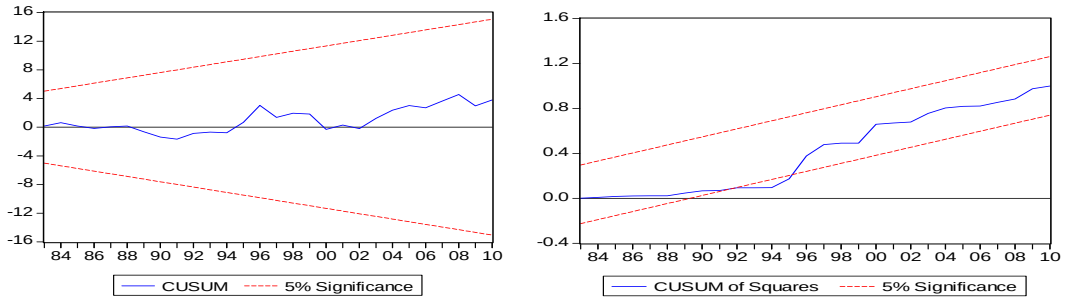
the similarity of variance across the term, serial correlation test for the absence of autocorrelation at any order, ARCH-LM test and Ramsey test for the stability of estimated parameter, all mention the absence of any econometric problem regarding the stability of parameter of our short-run error-correction estimates particularly. The plotting of CUSUM lying within critical bound strongly supports the convergence of parameters in the long run but the plotting of CUSUM of the squares does not lay within the given bound supports the evidence of divergence of short-run estimates in the long run.

Table 5.14: Diagnostic and Stability Test of Short-run Error Correction:

	F-Statistics	**Probability**
χ^2_{NORM}	0.687393	0.709144
χ^2_{WHITE}	1.088353	0.429714
χ^2_{RAMSEY}	0.043357	0.836618
$\chi^2_{ARCH-LM}$	0.190602	0.665176
$\chi^2_{Serial\,Corr}$	0.710819	0.500541

Note: For normality test, we report Jeque-Bera statistics.

χ^2_{NORM}, χ^2_{WHITE}, χ^2_{RAMSEY}, χ^2_{ARCH}, $\chi^2_{Serial\,Corr}$ are non-normal errors normality test, white hetroskedasticity test, Ramsey Regression Specification Error Test, and Auto regressive Conditional Hetroskedasticity (ARCH Test), Serial correlation Lagrange Multiplier Test (LM-type Breusch-Godfrey-Test). These statistics are distributed as Chi-square values and capture degree of freedom on first-right column.



To sum up, we find that real exchange rates and nominal exchange rates increase the output of Pakistan in the short run but these results disappear in the long run where the exchange rate is negatively related to the output level. The relative price ratio has been insignificant in both short and long run, indicating that there is one-to-one relationship between nominal and real exchange rate. The terms of trade are favorable for Pakistan in the short run in both versions of the equation but it becomes negative in the long run. The government expenditure to real income ratio is negatively related to the output not only in both versions of the equation but also in both time spans of life. The factor of surprise money has been insignificant in the analysis which the classical economist would strongly support.

5.4. GRANGER CAUSALITY TEST

After interpreting the econometric results of our basic models, there is need to highlight the given issue with the help of bivariate causality tests of real GDP and real exchange rate for a full sample in order to find in which direction the causality runs.

The cross-correlation analysis explained in Chapter IV doesn't help us more specifically in evaluating the causality among the series. There is a need to examine the direction of causality more precisely that controls the effect of other lagged forms of the two underling variables. For that purpose, this sub-section conducts the Bivariate Granger causality test between real GDP and real exchange rate where causality refers to the ability of one variable to predict the other and it is the good feature of vector autoregressive model (VAR) and (Asteriou & Hall, 2007). We analyze the causality

between real GDP and real exchange rate and the possible situations that have meaning under causality are (a) real GDP causes real exchange rate (b) real exchange rate causes real GDP (c) there exists a bi-directional causality i.e. both variables cause each other (d) there is no causality (two variables are independent). We follow the Granger (1969) and conduct Granger causality test: the test equations are as follows:

$$\ln rer_t = \alpha_2 + \sum_{i=1}^{n} \delta_i \ln y_{t-j} + \sum_{i=1}^{n} \gamma_i \ln rer_{t-i} + \varepsilon_{1t} \qquad (5.1)$$

$$\ln y_t = \alpha_1 + \sum_{i=1}^{n} \beta_i \ln rer_{t-i} + \sum_{i=1}^{n} \phi_i \ln y_{t-j} + \varepsilon_{2t} \qquad (5.2)$$

Where, $\ln y_t$ is the log of real GDP, α_i is intercept terms, $\ln rer$ is log of real exchange rate and $t-i, t-j$ refer to the desirable lags. In VAR, we introduce the desirable lags by following the lag selection criteria. In our analysis, we just take two lags that provide minimum value by each method mentioned in table (5.15).

Table 5.15: Lag Selection Criteria: (Log of Real GDP and Log of Real Exchange Rate)

Lag	LR	FPE	AIC	SC	HQ
0	NA	25.98268	8.933156	9.021129	8.963861
1	77.57497	3.094548	6.804621	7.068541	6.896736
2	**14.23152***	**2.448859***	**6.567762***	**7.007628***	**6.721287***
3	2.375441	2.835871	6.708072	7.323885	6.923008

Note: * indicate the lag order selected by the different criteria. Where, LR, FPE, AIC, SC, HQ denote the sequential modified LR test statistics (each teat at 5%level), Final prediction error, Akaike information criteria, Schwarz information criteria, Hannan-Quinn information criteria, respectively.

We develop the null and alternative hypothesis that

$$H_0 = \sum_{i=1}^{n} \delta_i = 0$$ or real output does not Granger cause real exchange rate

$$H_1 = \sum_{i=1}^{n} \delta_i \neq 0$$ or real output does Granger cause real exchange rate

And

$$H_0 = \sum_{i=1}^{n} \beta_i = 0$$ or real exchange rate does not cause real output

$$H_1 = \sum_{i=1}^{n} \beta_i \neq 0$$ or real exchange rate does cause real output

By estimating equation (5.1) and (5.2) and applying the Wald coefficient restriction test for the entire null hypothesis mentioned above we find that if the F-critical exceeds the computed F-statistics or, alternatively, the probability values of F-statistics lie above the 10 percent, we accept the null hypothesis of GDP that it doesn't cause real exchange rate or the real exchange rate doesn't cause real output. In spite of proving the causality of real exchange rate and real output in logarithmic form, we employ many other options such as the first difference of logarithmic form, the deviations from the linear, from the quadratic an from the cubic trends, as well as the Hodrick-Prescott (H-P) Filtered and the deviation from Hodrick-Prescott (H-P) Filtered trend.

Table 5.16: Granger Causality Tests: Real Gross Domestic Product (GDP) and Real Exchange Rate

Variables	Logarithmic Form	First Difference of Logarithmic Form	Deviation from Linear Trend	Deviation from Quadratic Trend	Deviation from Cubic Trend	HP Filtered	Deviation from the HP Filter Trend
Real GDP	3.342 (0.048)	0.168 (0.845)	0.192 (0.825)	0.112 (0.894)	0.322 (0.727)	229.11 (0.000)	173.3 (0.00)
RER	0.055 (0.945)	0.517 (0.949)	0.044 (0.956)	0.486 (0.619)	0.163 (0.849)	10.28 (0.004)	61.59 (0.00)

Note: The *F*-statistics are reported here along with *p*-values in parentheses. Two lags are used in the regression analysis.

We reported the results of the Granger causality test in table (5.16) above with the alternative specification as already mentioned. We develop the null hypothesis that real GDP does not Granger cause to real exchange rate and alternatively, the real GDP does Granger cause to real exchange rate and vice versa. The null hypothesis of real GDP does not Granger cause to real exchange rate is rejected in logarithmic form for 4 percent level of significance. Alternatively, the null hypothesis of real exchange rate does not Granger cause to real GDP is accepted i.e there is no causality from real exchange rate to real output. However, the transformations such as first difference of logarithmic form, deviations from the linear, quadratic and cubic trends indicates that the null hypothesis of real output does\ not Granger cause to real exchange rate and real exchange rate does not Granger cause to real output, is not rejected. The given analysis indicates that there is no causality from any direction.

The findings based on H-P Filtered and deviation from H-P Filtered trend evaluate that the null hypothesis of no causality is rejected in both the frameworks i.e. there exists bi-directional causality running from real exchange rate to real output and real output to real exchange rate. In sum, it can be said that alternative transformation or specification that the results of bi-direction causality mention are more apparent than uni-directional causality, which is obtained just from the logarithmic form. However, this result does not contradict the findings of this study based on cross-correlation analysis of causality running from real exchange rate to real output and real output to real exchange rate. The same findings along with extra conclusions (as bi-directional causality) are obtained from the Granger causality test.

To show the linkage of causality in which direction is an important part of the analysis, based on our transformation analysis of cross-correlation, we can say that both the leads and lags periods are more dominant for three out of seven transformation processes and the causality from real exchange to real output and real output to real exchange rate. This statement is based on statistically significant results.

Chapter 6

SUMMARY AND CONCLUSIONS

Exchange rate plays an important role in macroeconomic stability and economic growth. In many developing and transition economies, currency depreciation is often viewed as an instrument for generating employment, strengthen the current account through enhanced exports, and improve foreign exchange reserves. However, its role in affecting economic conditions of the economy, particularly on the output or growth level is still being debated among the policy maker, economist and forecasters in forex market. This study analyzes the issue of currency depreciation both theoretically and empirically within an open economy IS-LM framework and using the autoregressive distributive lag (ARDL) models for empirical testing.

The results show that the exchange rate or depreciation of domestic currency leads to a contraction in output both in IS-LM framework and long-run estimates of ARDL models. This may be due to a combination of both the supply-side and demand-side factors. However, in a short term perspective, currency depreciation leads to an increase in output as is the case within the standard open economy macroeconomic framework as expounded by Dorrnbusch. The sign and statistical significance of government spending in affecting the output level are in line with the above findings both in short and long-run that may be due to the crowding-out phenomena or excess of non-development spending in total government outlays.

The results show that the terms of trade positively affect the output level in short-run but have a negative impact in the long-run. On the monetary side, surprise money or surprise events of central bank have an insignificant role in output determination in both short run and long run. In order to analyze the impact of price level on output, real exchange rate is disaggregated into nominal exchange rate and the relative prices. The evidence indicates that relative prices are insignificant in explaining output and that there is a one-to-one relation between the real and nominal exchange rates.

The results indicate that currency depreciation may not be a viable option to boost output in the long run. Also, government spending leads to a reduction in output due to crowding-out of private spending. There is thus a need for the government to focus its attention on reducing the non-development expenditures and channel resources to enhance development spending to generate employment and growth.

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APPENDIX:

Appendix A 1:

Table A1.1: Result of Money Equation
Dependant Variable LogM2

Variables	Coefficients	t-values
Constant	0.074	2.187**
LogM2	0.361	2.193**
DHM	0.093	0.722
F-Stat 2.57 (0.09)	**AIC** -3.26	
D-W Stat 1.81	**SC** -3.13	

Note: ** stand for 5% level of significance. AIC, SC, D-W Stat stand for Akaike Information Criterion, Schwarz Criterion and Durbin-Watson Statistics, respectively.

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Table A1.1 reports the result of estimation of equation 4.1 that take desirable (one) lag of logM2, inclusion of more than one lag of dependant variable make the results less significant in statistical terms. The coefficient value of logM2 is 0.361 and also statistical significant at 5% level of significance. The coefficient value of deficit to high powered money is 0.093 that is insignificant, indicating that deficit is not important variable to influence the money growth in case of Pakistan.

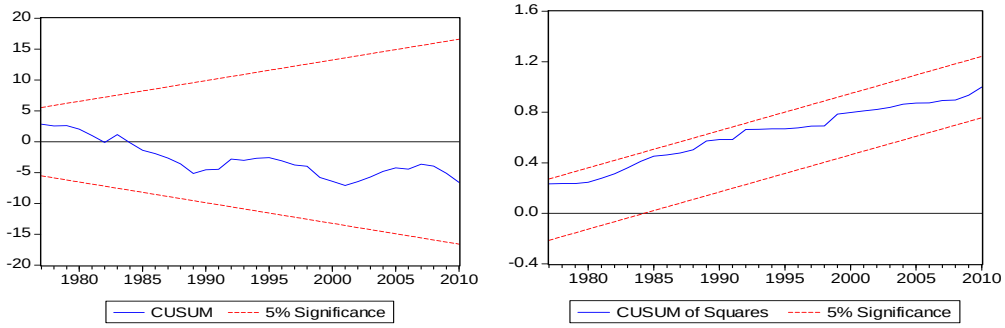
Table A1.2: Diagnostic and Stability Test:

	F-Statistics	Probability
χ^2_{NORM}	1.895826	0.387549
χ^2_{WHITE}	0.997751	0.423095
χ^2_{RAMSEY}	0.498980	0.484907
χ^2_{ARCH}	0.372326	0.545797
$\chi^2_{Serial\,Corr}$	1.162440	0.325578

Note: For normality test, we report Jeque-Bera statistics. χ^2_{NORM}, χ^2_{WHITE}, χ^2_{RAMSEY}, χ^2_{ARCH}, $\chi^2_{Serial\,Corr}$ are non-normal errors normality test, white hetroskedasticity test, Ramsey Regression Specification Error Test, and Auto regressive Conditional Hetroskedasticity (ARCH Test), Serial correlation Lagrange Multiplier Test (LM-type Breusch-Godfrey-

Test). These statistics are distributed as Chi-square values and explain the degree of freedom at last column.

Fig A1.1; Plots of CUSUM and CUSUM-square



All the diagnostic test mentioned in table A1.2 shows that there does not exist any econometric problem. The plots of CUSUM and CUSUM of square show the stability of all coefficients of all estimates.

Appendix A 2:

Table A2.1, Lag-length Criteria: Model 1

Lag	LR	FPE	AIC	SC	HQ
0	-	2.09e-06	1.109610	1.327302	1.186357
1	427.3641	8.42e-12	11.32498	**10.01883***	10.86450
2	**52.86556***	**4.61e-12***	**12.00692***	9.612310	**11.16271***

Note: * indicates lag order selected by the criterion. LR, FPE, AIC, SC, HQ stands for sequential modified LR test statistic (each test at 5% level), Final prediction error, Akaike information criterion, Schwarz information criterion, Hannan-Quinn information criterion, respectively.

The standard lag-length criteria of model 1 that take the estimation of real exchange rate to output are reported above in table A2.1. Different lag-length selection criterions such as sequential modified LR test statistics, Final predictor error, Akaike information criteria and Hannan-Quinn information report that standard lag length is 2 in the given analysis.

Table A2.2, Lag-length Criteria: Model 2

Lag	LR	FPE	AIC	SC	HQ
0	-	1.50e-08	0.989052	-0.727822	-0.896956
1	487.8099	9.35e-15	15.30343	**13.47483***	-14.65876
2	**68.71255***	**4.39e-15***	**16.22051***	-12.82452	**15.02327***

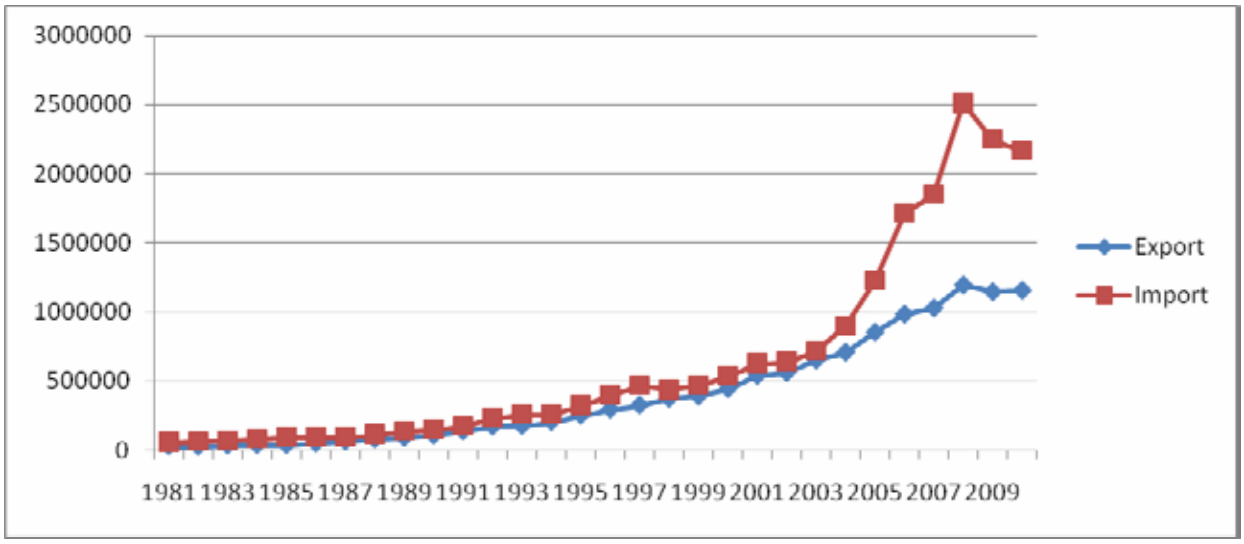
Note: * indicates lag order selected by the criterion. LR, FPE, AIC, SC, HQ stands for sequential modified LR test statistic (each test at 5% level), Final prediction error, Akaike information criterion, Schwarz information criterion, Hannan-Quinn information criterion, respectively.

The standard lag-length criteria of model 2 that take the estimation of nominal exchange rate and relative price ratio as independent variables and real output as dependant variable are reported above in table A2.2. Different lag-length selection criterions such as sequential modified LR test statistics, Final predictor error, Akaike information criteria and Hannan-Quinn information report that standard lag length is 2 in the given analysis.

Appendix, A3: Export and Imports of Goods and Services

The exports and imports of goods and services of Pakistan are plotted in the graph below.

Fig A3.1: Export and Imports of Goods and Services

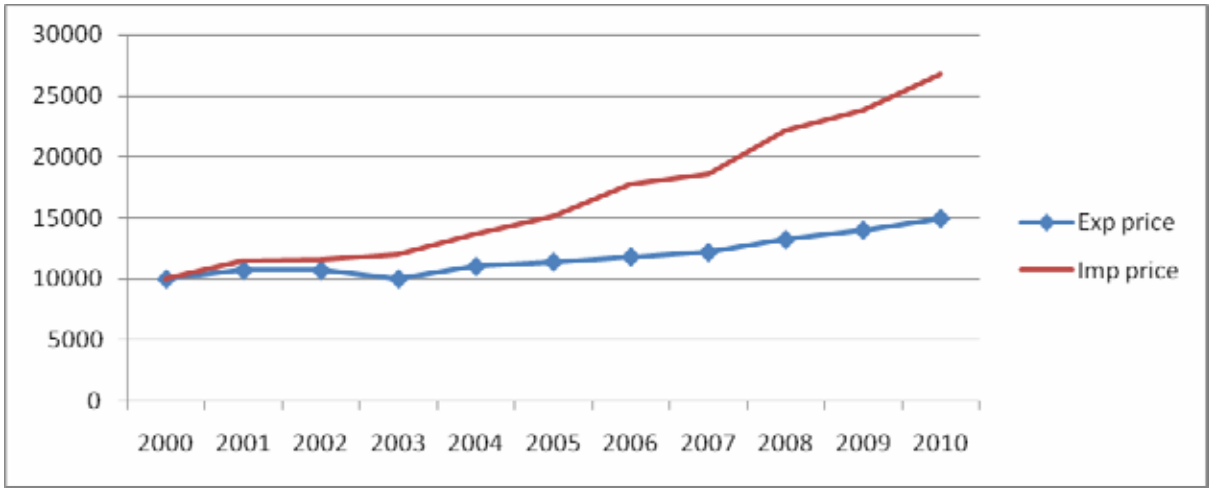


Source: Pakistan Economic Survey, 2010

It is cleared that imports of Pakistan have been higher than its exports since the period under consideration.

Appendix A4:

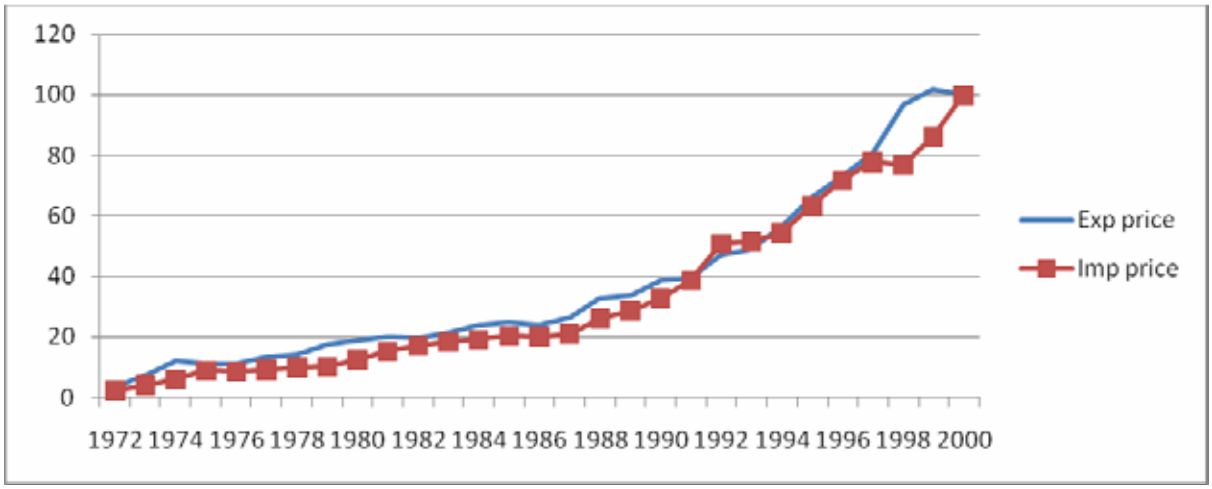
Fig: A4.1: Import and Export Price (2000-2010)



Source: Pakistan Economic Survey (Different issues)

The import price has been higher than export price since 2000.

Fig: A.4.2: Import and Export Price (1972-2000)

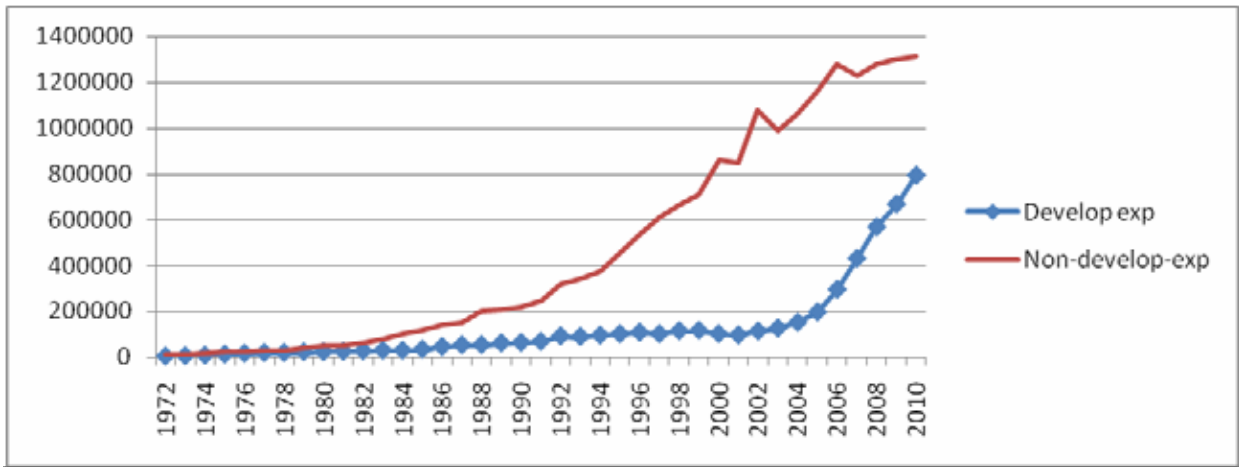


Source: Pakistan Economic Survey (Different issues)

The import and export price of 1972 to 2010 are plotted above. It is cleared that import price is almost has been less than export price during 1972 to 2000.

Appendix A 5:

Fig: A5.1: Development and Non-development Expenditure



Source: Pakistan Economic Survey (Different issues)

The plot of development and non-development expenditure clearly shows that non-development expenditure has been higher than development expenditure since 1978.

Appendix A 6:

Table A6.1: Financing of Fiscal Expenditure in spite of Tax revenue (million rupee)

	2007-08	2008-09	2009-10
External Sources	151.3	149.7	332
Domestic	**625.9**	**529.5**	**390.5**
-Bank	519.9	305.6	144.1
-Non-Bank	104	223.8	246.3
-Privatization Proceeds	1.7	1.3	0.1

Source: Economic survey of Pakistan (2010).

The financing of fiscal expenditure from different sources have been explained in above table A6.1. The table clearly shows that Pakistan has excess borrowing from both external and domestic source that has been increasing year by year. The borrowing from domestic resource is higher than external resources in 2010 as mentioned by 332 million rupees.