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The Impact of Exchange Rate on Output Level: Bounds Testing Approach for Pakistan

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1. INTRODUCTION

The stabilisation of growth process has been the aspiration of the nations in modern era. Since the industrial revolution in the world, most of the developing nations have been in the paradigm of chronic current account situation, loss in output, high import bill, less integration of their export sector, and less competitiveness in trade with the world. The process to devalue their currency may be evaluated as optimism for the improvement of their national growth that not only overcome the soaring trade deficit but also may be helpful to compete in international market. In theoretical literature, there has been contradiction among the researchers based on its effects in determining the net output of the economy.

Since the work of Cooper (1971) and Krugman and Taylor (1978), the ambiguity arises for the effects of currency depreciation on output and their pioneer work explain the demand side as well as supply side channels through which depreciation may appear as loss in net output. The devaluation induces higher prices of tradable products that appear as loss in real balance of the economy and ultimately result in less output and growth. Some studies [Krugman and Taylor (1978); Edwards (1986) and Lizondo and Montiel (1989)] also support to contractionay output hypothesis with the induction of income redistribution channel that just redistribute income from the wage earners towards profit earners having the excess savings. This process ultimately leads to less aggregate demand as well as output via meager consumption. On the supply side, depreciation of currency result in higher input cost and less output level [Krugman and Taylor (1978); Van Wijnbergen (1986)]. In addition, wage indexation mechanism is also important that reduces the net benefits on producer side and escorts to the contraction in output [Agenor and Montiel (1996)].

Traditional literature usually demonstrates the attractive picture of currency depreciation that is linked with the increase in output level [Gylfason and Schmid (1983); Dornbusch's (1988)]. In literature, there is a contestable debate for anticipated and unanticipated shocks of currency depreciation that may result in aggregate demand and

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output variations. Kandil (2008) and Bahmani-Oskooee and Kandil (2009) contribute in the literature by showing that unanticipated depreciation increases the net exports and money demand but decreases the output level.[1] The fluctuations of demand-side channel usually dominate the supply-side channel in determining the outcome of unanticipated currency depreciation that may appear as loss in output [Kandil (2008)]. In addition of that, the contractionary and expansionary hypothesis is also debatable in data relating literature where bivariate data analysis has been important feature to determine the direction and response of net output. Some studies generally relates with the negative as well as positive relation between gross domestic product and exchange rate [Berument and Pasaogullari (2003); Kim and Ying (2007)], while others explain the unambiguous findings [Kamin and Rogers (2000)].

The major objective of this study is to examine the movements in real GDP due to the changes in (nominal) exchange rate or the combination of exchange rate and price level both in short and long-run by applying the bounds testing approach. It observes the role of price ratio in determining the output level in a given framework that particularly relates with the relation between nominal and real exchange rate. The research also conducts the bivariate-data analysis in the context of cross-correlations and Granger-causality of (real) exchange rate 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. The study consist of four sections, where second section is about data, variables and econometric methodology, the third section explains and interprets the results, while last one is about the concluding remarks of the research.

2. DATA, VARIABLES AND ECONOMETRIC METHODOLOGY

This section provides the data, variables and description of methodology that is used to find out the empirical relation among the variables. The conduction of bivariate data analysis with the assimilation of cross-correlation scrutiny and the application of Granger causality test is also the subject theme of this section.

2.1. Data and Variables

Since the separation of sub-continent, Pakistan economy has been the victim of exchange rate shocks that requires both its implication and effects on output with the help of annual data set from 1972 to 2010.

Real output (real GDP) is the dependant variable that is measured by the market value of final goods and services produced domestically in local constant currency. The study utilises the work of Khan and Knight (1981) that considers the application of fiscal expenditure in determining the aggregate production in developing countries. For that assertion, the ratio of government expenditure to (constant) GDP is considered by taking the data set from "50 Years of Pakistan Statistical Supplement" and Economic Survey of Pakistan (ESP). The insertion of monetary policy in determining the aggregate production is followed by the work of Khan and Knight (1981) and Edwards (1986) that include the theory of rational expectation and substitute the money supply term by money surprise or unexpected money growth. The surprise money shock of central bank is also employed

[1]These results are also consistent with the Kandil, *et al.* (2008).

with the incorporation of unexpected money growth term (money surprise term) [$\Delta\log M - \Delta\log M^*$] that takes the distinction between the actual money growth and the estimated rate of growth of money.[2]

Terms of trade is used as explanatory variable and defined as the ratio of export price to import price with the data taken from "Handbook of Statistics on Pakistan Economy 2005" published by State Bank of Pakistan (SBP). Exchange rate is the main explanatory variable of interest that is measured by indirect version as local currency in terms of foreign currency, and (P/P^*) is the ratio of domestic price to world price level. The data for relative price ratio and nominal exchange rate is extracted from World Development Indicator (WDI). The response of dependant variable "real GDP" with the core explanatory variable "(real) exchange rate", is conducted through bivariate data analysis that finds out the dimension and response of "real GDP" [Kamin and Rogers (2000)]. In addition to that, the application of bivariate causality test is also conducted for full sample that analyse the direction of causality.

2.2. Bivariate Data Analysis

The robustness, sensitivity of cross-correlation and particularly, the disagreement about the equilibrium value of exchange rate may compel us to exploit the different transformation of data such as logarithmic form, first difference of logarithmic form, deviation from linear trend, deviation from quadratic trend, deviation from cubic trend, Hodrick-Prescott (H-P) Filtered, and deviation from Hodrick-Prescott (H-P) Filtered trend. The given transformation analysis also helps out to check whether the co-movements of real exchange rate and GDP are opposite or not i.e., contractionary or expansionary devaluation/depreciation works. The given process is conducted with different leads and lags up to four periods.

Table 1

Cross-correlations between the GDP and Exchange Rate from1972-2010

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 percent, 5 percent, and 10 percent, respectively.

[2]By following the work of Edwards (1986) and ACAR (2000), the estimated equation of money growth incorporates the high powered money and fiscal deficit as independent variable. The data set along with methodological procedure is available to author and can be obtained on demand.

Cross-correlation analysis with different transformation gives us contradictory result such as negative as well as positive values shown by logarithmic form and H-P Filtered, while deviation from H-P Filtered trend explains that real exchange rate is negatively correlated with the real output. The findings based on the different transformation are almost biased towards both the reduction and increment in GDP due to the depreciation of domestic currency.

Cross-correlation analysis have an unambiguous findings that further requires the conduction of Bivariate Granger causality test between GDP and 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 [Asteriou and Hall (2007)]. The issue of causality is considered between real GDP and real exchange rate and possible situation under causality can work are (a) real GDP causes real exchange rate (b) real exchange rate causes real GDP (c) there exist bi-directional causality, i.e. both variables cause each other (d) there does not exist causality (two variables are independent). We follow the Granger (1969) and conduct granger causality test that have the equations:

$$\ln rer_t = \alpha_1 + \sum_{i=1}^{n} \delta_i \ln y_{t-J} + \sum_{i=1}^{n} \gamma_i \ln rer_{t-i} + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$$\ln y_t = \alpha_2 + \sum_{i=1}^{n} \beta_i \ln rer_{t-i} + \sum_{i=1}^{n} \phi_i \ln y_{t-i} + \varepsilon_{2t} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where, ln y_t, α_i, ln *rer, t–i, t–j* stand for log of real GDP, intercept terms, log of real exchange rate and desirable lags. In VAR, the desirable lags are taken by following the general lag selection criteria and two lag are employed in our analysis. The null and alternative hypothesis is

$$H_0 = \sum_{i=1}^{n} \delta_i = 0$$ or Real output does not cause real exchange rate (vise versa),

and $$H_0 = \sum_{i=1}^{n} \beta_i = 0$$ or Real Exchange rate does not cause real output (vise versa).

The results of causality test along with alternative specification are reported in Table (2). The alternative transformation or specification shows that the results of bi-direction causality are more apparent than uni-direction causality, which is obtained just from the logarithmic form. However, this result does not contradict with our findings based on cross-correlation analysis that shows the causality 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 causality test. After the brief description of data source, variables and bivariate data analysis such as cross-correlation and causality analysis, now, there is a need to explain the econometric technique that is used to regress the econometric model for empirical analysis.

Table 2

Causality Tests: GDP and 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	3.342	0.168	0.192	0.112	0.322	229.11	173.31
GDP	(0.048)	(0.845)	(0.825)	(0.894)	(0.727)	(0.000)	(0.000)
RER	0.055	0.517	0.044	0.486	0.163	10.28	61.59
	(0.945)	(0.949)	(0.956)	(0.619)	(0.849)	(0.004)	(0.000)

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

2.3. Econometric Methodology

For empirical specification, the work of Edward (1986) and rational expectation framework is employed along with the money surprise or unexpected money growth term. The research also utilises the role of devaluation and trade in assessing the real aggregate output by using the exchange rate, relative price ratio, terms of trade, monetary and fiscal as explanatory variable. The estimated equation is as follows:

$$\log y_t = \alpha_1 + \gamma\, time + \beta_1 \log\left(GE/Y\right)_t + \beta_2\left[\Delta \log M - \Delta \log M^*\right]_t + \beta_3 \log \tau_t$$
$$+\beta_4 \log e_t + \beta_5 RPR_t + \varepsilon_t \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (3)$$

Where, $\alpha_i, y, \left(GE/Y\right), \left[\Delta \log M - \Delta \log M^*\right], \tau, e, RPR, \gamma$ stand for intercept term, aggregate real output, ratio of government expenditure to real income, unexpected rate of money growth (money surprise term), terms of trade, nominal exchange rate, relative price ratio and coefficient of time trend, respectively. The stationary issue for time series data is also conducted that may help us to avoid from the issue of spurious regression that is obtained by simply regressing the equation by ordinary least square [Granger and Newbold (1974)]. We apply the two famous test of stationary Augmented Dickey-Fuller (ADF) test by Dickey and Fuller (1979) and Phillips-Perron test by Phillips (1987) and Phillips and Perron (1988). Whereas, 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. This process helps us to move further for cointegration or existence of long-run relation.

The findings of unit-root test reported in next section explains that variables are the combination of integrated of order zero $I(0)$, and order one $I(1)$. The different orders of stationary requires that Johansen cointegration is not applicable here and the issue is tackled by the Bounds testing approach or auto regressive distributive lag (ARDL) model developed by Pesaran, *et al.* (2001). Moreover, we develop the conditional error-correction model (CECM) that does not require the unit root testing procedure and applicable whether the variables are $I(0)$ or $I(1)$ or mixture of both series.[3] The unrestricted error-correction model (UECM) is written as:

[3]Narayan and Narayan (2007) explains that bounds-testing approach to cointegration is also applicable in small sample.

$$\Delta ly_t = \gamma\, time + \sum_{i=0}^{k} \beta_{1i}\, \Delta ly_{t-i} + \sum_{i=0}^{k} \beta_{2i}\, \Delta l\left(GE/_{Y}\right)_{t-i} + \sum_{i=0}^{k} \beta_{3i}\, \Delta\left[\Delta lM - \Delta lM^{*}\right]_{t-i}$$
$$+ \sum_{i=0}^{k} \beta_{4i}\, \Delta l\tau_{t-i} + \sum_{i=0}^{k} \beta_{5i}\, \Delta le_{t-i} + \sum_{i=0}^{k} \beta_{6i}\, \Delta lRPR_{t-i} + \varphi_1 ly_{t-1} + \varphi_2\, l\left(GE/_{Y}\right)_{t-i}$$
$$+ \varphi_3\left[\Delta lM - \Delta lM^{*}\right]_{t-i} + \varphi_4\, l\,\tau_{t-1} + \varphi_5\, l\, e_{t-i} + \varphi_6\, lRPR_{t-i} + \varepsilon_t \qquad \ldots \qquad \ldots \qquad (4)$$

Δ is the first-difference operator that is used for short-run analysis, while long-run variables are explained in lag form. The joint significance test is conducted for the existence of long-run relation among the series by applying the restrictions on all long-run variables as they are absent from the equation. Cointegration analysis requires that calculated F-stat is greater than the upper critical bounds tabulated in Pesaran, *et al.* (2001). The standard lag length criteria is conducted by following the Akiake Information Criteria (AIC) and Schwarz-Bayesian Criteria (SBC) that choose the optimal lag structure. Empirical findings for devaluation effect on output contradict for time horizon and different researchers find different conclusion based on their size and region. Sencicek and 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, respectively. 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 for Greece and Cyprus economy. [See also, Kandil (2008)].

The short-run error correction model can be written in Equation (5). Error correction term should take statistically significant negative coefficient that measures the extent to which the correction of error takes place from short period to long period due to random shocks.

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

EC_{t-1} is lagged error-correction term. The diagnostic and normality test namely, White Hetroskedasticity, ARCH-LM test, serial correlation LM-test and Ramsey test are also conducted. The stability of the ARDL model for short-run coefficients of ECM mechanism is checked by applying CUSUM (cumulative sum of recursive residuals) and CUSUMQ (cumulative sum of recursive residuals of square) tests developed by Brown, *et al.* (1975).

3. ESTIMATION RESULTS AND INTERPRETATIONS

The theoretical and empirical literature explains the controversy about the linkages among currency depreciation, output and price level. The research contribute in the debate with the help of annual time series data for Pakistan and Bounds testing approach to ARDL that considers the response of dependant variable “real output” due to the stationarity of the variables at different order. The results of Augmented Dickey-Fuller (ADF) and Phillip-Parron (PP) tests by applying logarithm and constant or constant and trend for stationarity (wherever it is applicable or significant) are reported in Table (3). The stationary results show that variables under consideration are integrated of order zero *I*(0) and one *I*(1) or combination of both orders.

Table 3

Results of Unit Root Test (ADF and PP Test)

Variables	Constant / Constant and Trend	Level (PP)	Ist-difference (PP)	Level (ADF)	Ist-difference (ADF)	Order of Integration
lngdp	Constant	–1.49	–4.14***	–2.47	–4.17***	*I(1)*
lngery	Constant and Trend	–3.33*	–5.50***	–3.57**	–5.53***	*I(0)*
lnner	Constant and Trend	–5.28***	–22.8***	–5.27***	–6.67***	*I(0)*
lnpp	Constant	0.31	–2.62*	–2.51	–3.41*	*I(1)*
lntot	Constant and Trend	–2.44	–8.97***	–2.42	–7.02***	*I(1)*
lnsmon	Constant and Trend	–7.04***	–22.1***	–7.10***	–3.36*	*I(0)*

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

In both tests, real gross domestic product (GDP), relative price ratio and terms of trade are non-stationary at level along with the desirable intercept and trend term but it becomes stationary at first difference, i.e. *I*(1). The nominal exchange rate, ratio of government expenditure to real income and surprise money are stationary at level, mentioning that they are integrated of order zero *I*(0). Since, the results of both tests appraise that the order of integration is not same and the application of ARDL approach is desirable for the existence of long-run relation among the variables. The specified analysis has been conducted in unique way and reported below.

3.1. Results and Discussion

The estimation result and discussion based on economic theories are explained in this sub-section. For ARDL process, the reaction of all explanatory variables is conducted by applying both the two lags[4] and general to specific rule.[5] Where, the latter one process may improve both the significance of the model and the information criteria as mentioned by AIC and SBC criteria's.[6] The analysis for the existence of long-run relation among the series requires the application of bounds testing approach to cointegration. In that technique, the coefficient of all long-run variables are adjusted or restricted to zero. The resulting value of F-statistics indicates the rejection of null hypothesis of no cointegration at zero percent level of significance. Its value is 8.11 with the probability value 0.001. Since, this value of F-statistics lies above the upper level *I*(1) having one percent level of significance that declares the presence of cointegration among the variables in long-run.

[4]The lag-length for the estimation of Equation (4) is followed by the standard lag-length criterion i.e. AIC and SBC and two lags are applied in our analysis.

[5]It removes the highly insignificant or less significant (>0.05 p-value) variables from the equation.

[6]The result of ARDL model is reported in Appendix (Table A.1) in which the combination of both long and short-run variables appear.

Table 4

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

Note: Lower *I*(0) and Upper *I*(1) mention the value of F-statistics for lower and upper bounds.

After developing the long-run relation among the series, there is a need to obtain the normalised long-run estimates of ARDL model through normalisation process that are reported in Table (5). The nominal exchange rate is negatively related with the output level in long-run with the coefficient value –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 value of nominal depreciation follows both the demand side and supply side channels in long-run that determine the contractionary output level for Pakistan. On the demand side, the income redistribution,[7] real balances,[8] import cost, tax structure, external debt, and trade liberalisation channels, while, on the supply side, imported input cost, cost of working capital and wage indexation channels work that support to the contractionary output hypothesis [Kalyoncu, *et al.* (2008)].

Table 5

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

Regressors	Coefficients
$lgery_{t-1}$	–6.80265***
$lner_{t-1}$	–1.19418***
$lrpr_{t-1}$	–1.68301
$ltot_{t-1}$	–1.94116*
$lsmon_{t-1}$	–3.30028

Note: ***,* Denote the significance level at 1 percent and 10 percent level of significance, respectively.

Another dependent variable in the analysis is relative price ratio that is negatively related with the output level of the economy but it has been insignificant both in short and long-run. Its coefficient value is –1.68, demonstrating that one percent increase in relative price ratio leads to 1.68 percentage point reduction in output level of the economy. The insignificance of relative price ratio explains that it has not any effect on the output level of the Pakistan. In other words, there is one to one relation between the real exchange rate and nominal exchange rate or nominal depreciation leads to real deprecation [Sencicek and Upadhyaya (2010)]. In order to capture the effect of monetary policy, the surprise money is used as independent variable that has an expected sign but it is insignificant in

[7]It base on two classes such as wage and profit earners.

[8]It explains that the depreciation of domestic currency may increase the general price level due to high price of trade-able products as compared to non trade-able products that ultimately result is reduction of real money balances and hence, output level.

long-run as its coefficient value is –3.30. In addition, these results are contrary to the Khan and Knight (1976) statement that monetary variable are important to determine the output level of the economy in developing countries. Terms of trade is negatively related with the output level in case of Pakistan along with coefficient value –1.94 that is significant at 10 percent level of significance. The logical interpretation usually relates with the higher export bill before 2000 that respond to more income as well as consumption on imported raw material, particularly on luxury items and may result loss in output level of the economy. In addition, higher import bill after 2000 may require the loss in national income of the Pakistan. In this way, terms of trade may decrease the output level of the economy.

For fiscal policy analysis, the ratio of "government expenditure to real income" is negatively related with the output level in long-run along with the coefficient value –6.80, indicating that one percentage increase in government expenditure to real income may leads to 6.80 percentage point reduction in output level of the economy. These results strongly support to classical phenomena of crowding out, in which increase in government expenditure may lead to the reduction in output. In addition to that, number of reasons such as that increasing non-development spending, political instability and investment risk has been influential that may result in loss in aggregate demand in the presence of high government spending.

Table (6) below reports the results of short-run error correction estimates[9] based on Equation (7). The error correction term is negative and statistically highly significant, having coefficient value -0.06 and explaining that in short-run all variables move to long-run equilibrium with slow speed of adjustment. The value of R-squared is 0.64, evaluating that 64 percent variation in nominal exchange rate along with price ratio is explained by the model. The value of Durbin-Watson test and the model information criteria mentioned by AIC and SBC are well defined.

Table 6

Short-run Error Correction Estimates

Variable	Coefficient	Standard Errors	t-Statistics	Probability
$\Delta lgery_t$	–0.172763***	0.047023	–3.673989	0.0010
$\Delta lner_{t-1}$	0.018835***	0.006225	3.025573	0.0053
$\Delta lrpr_{t-1}$	0.076830	0.066117	1.162044	0.2550
$\Delta ltot_{t-1}$	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	AIC	–5.393126	
D-W Stat	2.288749	SBC	–5.001281	

Note: *** Denotes the significance level at 1 percent 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.

[9]The stability and diagnostic test of short-run ECM are reported in Appendix Part A.2. (Table A.2).

In short-run, nominal exchange rate is positively related to the output level with coefficient value 0.01, which shows that one percentage increase in nominal exchange rate may give us 0.01 increase in real output of Pakistan. The nominal depreciation or increase in exchange rate in short-run may lead to reduction in the price of exported goods or increase in the price of imported products. The short-fall in exported price may compel to the foreigner to increase the imports of the products that may increase the net export and aggregate demand of the economy. In this way, currency depreciation in nominal term may lead to the increase in output level of the economy in short-run, strongly supported by traditional theories of open economy macroeconomics.

The sign of relative price ratio is positive in affecting the output level for Pakistan but it is insignificant in case of Pakistan, strongly support to the evidence that nominal exchange rate and real exchange rate are one to one related and all increase in output arises from nominal to real exchange rate, not from relative price ratio [Sencicek and Upadhyaya (2010)]. Terms of trade is positively related with the output, indicating that it has been favourable in short-run due to the positive windfall in the economy. Surprise money is used as an explanatory variable in order to define the monetary framework that is negative and insignificant in the given model. Its insignificance mainly support to the classical economist in which any surprise event of central bank remains unable to affect the output level of the economy. Fiscal side has been an important determinant to affect the output level of economy but it is negatively related with the output level along with the coefficient value –0.17, stating that one percentage increase in government expenditure to real income may cause to reduce the output level of the economy by 0.17 percentage point. It has been due to the crowding out and overspending on non-development side.

To sum up, the findings explain that nominal exchange rate increase the output of Pakistan in short-run but these results disappear in long-run, in which exchange rate is negatively related with the output level. The relative price ratio has been insignificance in both short and long-run, indicating that there is one to one relation between nominal and real exchange rate. Terms of trade are favourable for Pakistan in short-run but not beneficial in long-run. The government expenditure to real income is negatively related with the output in both time spans. Surprise money is insignificant in all of the analysis, strongly supported by the classical economist.

4. CONCLUDING REMARKS

Currency depreciation has been significant device that is used to stabilise the growth process in many developing economies. In addition, the increasing dependence of developing nations over developed nations, globalisation, macroeconomic shocks, dwindling import-export condition and soaring trade deficit have compelled the nations to depreciate their currencies that is mainly used for the improvement of macroeconomic condition. But its channel to affect the output level is highly controversial issue in open economy literature. This research contributes in the literature empirically by using the Bounds testing approach to autoregressive distributive lag (ARDL) model for Pakistan.

The findings of nominal exchange rate supports to the contractionary output in long-run but similar findings are not obtained in short-run, where depreciation of exchange rate induces higher output as supported by Dornbusch (1988). The downfall of output in long-run is mainly explained by the combination of both the supply-side and demand-side channels. In addition, the sign and statistical significance of government spending mainly induces the reduction in output in both short and long-run that may be due to the crowding-out phenomena or excess of non-development spending from total government outlays. The results also support that the terms of trade is positively related with the output level in short-run but have a contractionary 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 and long-run. In addition to that, the conclusion of Bivariate data analysis based on cross correlation scrutiny and causality test show that there exist both the contractionary and expansionary output due to currency depreciation. In this way, the results explore the new dimension for policy-makers and forecaster in forex market that nominal depreciation is not supporting to increase the output level in the long-run. In addition, fiscal sector is shock producing rather than shock absorbing as it induces crowding-out of private spending. It further suggests to the government that reduction in non-development spending and increment in the spending on development sector may be helpful tool for the enhancement of employment and economic growth.

APPENDIX

A.1.

The results of Equation (4) are reported in Table A.1.

Table A.1

Results of ARDL Estimated Model

Dependant Variable	Variable Coefficient	Δly_t Standard Errors	t-Statistics	Probability
$\Delta lgery_t$	–0.176330***	0.058095	–3.035215	0.0059
$\Delta lner_{t-1}$	0.018542**	0.009082	2.041546	0.0528
$\Delta lrpr_{t-1}$	0.069921	0.078385	0.892023	0.3816
$\Delta ltot_{t-1}$	0.105810***	0.041054	2.577300	0.0168
$\Delta lsmon_{t-1}$	–0.106818	0.069503	–1.536888	0.1380
trend	0.018858***	0.004033	4.676318	0.0001
ly_{t-1}	–0.028417**	0.013509	–2.103499	0.0466
$lgery_{t-1}$	–0.193311***	0.041591	–4.647964	0.0001
$lner_{t-1}$	–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		**AIC**	–5.178588
D-W Stat	2.396619		**SBC**	–4.569051

Note: ***, **,* Denote the significance level at 1 percent, 5 percent and 10 percent 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.

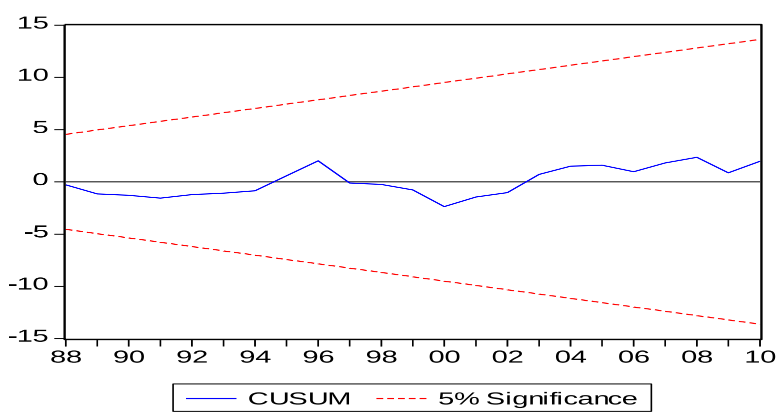
The performance of the estimated equation is good as mentioned by the R-squared and the value of Durbin-Watson statistics is 2.39 that is closer to the standard level, indicating the absence of auto-correlation at any lag. The cointegration vector term is negative and statistically highly significant that evaluating the convergence of all explanatory variable in long-run to their mean value.

Table A.1.1

Diagnostic and Stability Test of ARDL Estimated Model

	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_{RAMSEY}, $\chi^2_{ARCH-LM}$, $\chi^2_{Serial\ Corr}$, χ^2_{NORM}, χ^2_{WHITE}, 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.



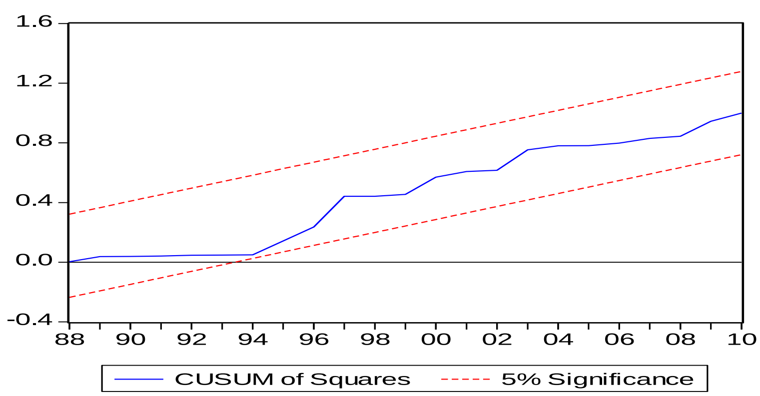


Table A.1.1 reports the result of diagnostic and stability test of estimation of Equation (2.5) that are all close the desirable level. The stability test in sense of CUSUM and CUSUM-square as plotted above that show the stability and movement of all variable towards dynamic equilibrium both in short and long-run.

A.2.

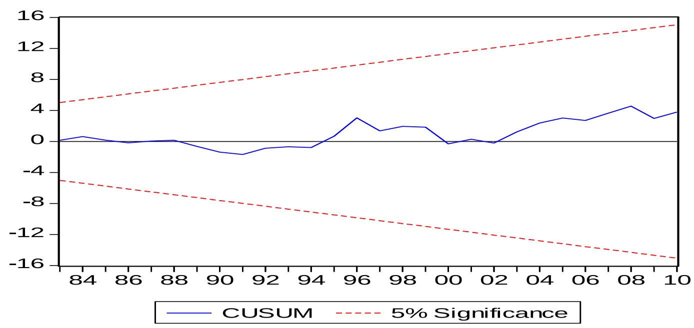
The diagnostic and stability test of short-run ECM are reported here in Table A.2.

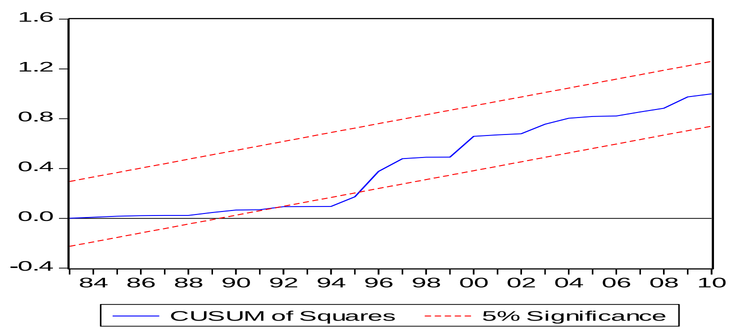
Table A.2

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
$\chi^2_{SerialCorr}$	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.





All diagnostic and stability test of short-run error correction model have been reported above explain the absence of any problem.

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