Devaluation and Output Growth: Evidence from Pakistan

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Abstract *This article investigates the long run and short run effect of currency devaluation on output growth of Pakistan by applying unit root and cointegration analysis. The data set includes annual observations for the period 1980-2009. Moreover, this study examines four alternative but equally plausible hypotheses, each with different policy implications. These are: i) Real GDP cause Real Effective Exchange Rate (the conventional view), ii) Real Effective Exchange Rate cause Real GDP, iii) There is a bi-directional causality between the two variables and iv) Both variables are causality independent (although highly correlated). The empirical evidence finds significant positive relationship between devaluation and output growth in long run, as well as in short run. Both in the long and short run, output growth are affected by currency devaluations.*

Keywords: *Devaluation, Output, Co-integration, Error Correction Mechanism, Pakistan*

1. Introduction

There are several schools of thought that built the foundation for devaluation of domestic currency. The most common are elasticity approach, monetary approach and absorption approach. It is common to find arguments for and against the devaluation, but the issue is to find the effects of devaluation on trade and output growth, as the devaluation lowers the exports prices and raises the prices of imports. The relationship between the output growth and the real exchange rate is an important for economies. Economists often considered devaluation to be a tool for improving the foreign sector of an economy. According to the traditional views the devaluation has expansionary effect on output and aggregate demand.
Contrary to the traditional view, there are other theoretical reasons why devaluation can have a contractionary impact on the economic activity. First, the devaluation can redistribute income from groups with a lower to a higher marginal propensity to save. This may lead to a decline in aggregate demand and output (Krugman and Taylor, 1978). Secondly, a nominal devaluation can decrease the aggregate demand through the negative real balance effect due to a higher price level, which in turn may decrease the level of output. Thirdly, if the price elasticities of exports and imports are very low, then the trade balance expressed in terms of domestic currency may deteriorate causing a recessionary effect in the economy. In addition to these demand-side effects, there are also a number of supply-side channels through which devaluation can be contractionary. Exchange rate depreciation raises the cost of imported inputs, leading to a decrease in aggregate supply. Additionally, exchange rate depreciation may raise the domestic interest rate and wage level through an increase in the price level. This might also decrease the aggregate supply in the economy (Kalyoncu et al., 2008).

Pakistan has been facing the problem of trade deficit since its creation in 1947. To improve the trade balance and output growth level Pakistan had experienced a series of devaluation in different periods of time from 1955 to up till now. After 1982 the country is experiencing a continuous devaluation in the rupee against dollar (Zaiby, 2009). The government and policy makers of Pakistan tried different exchange rate policies. Due to frequent appreciation of dollar against other major currencies, Pakistan adopted the managed floating exchange rate system in January 1982. The exchange rate observed much larger devaluation in nominal terms as there is a higher level of inflation in Pakistan in the beginning of 1990's compared to other major trading partners. In July 2000, State Bank of Pakistan moved away from managed exchange rate to floating exchange rate regime. There was a nominal depreciation of 18.5 percent during fiscal year 2001, which showed the market overvaluation during fiscal year 1999 and 2000 (Hyder and Mehboob, 2005).

The paper is organized as follows. In section 2, related literature is discussed and in section 3, methodology is discussed. The section 4 presents the data and empirical results and section 5 concludes the paper.

2. Literature Review

The relationships between devaluation and output growth have been investigated by a number of researchers. They found mixed results for devaluation and its impact on output growth. Edwards (1986) claimed that devaluations have a negative effect on output in the short-run while they are neutral in the long-run using pooled time series cross-section data for 12 countries. Sheeley (1986) found that devaluations have a negative impact on output for 16 Latin American countries. Conoly (1983) and Gylfason and Schmid (1983) found a positive relationship between currency devaluation and output growth. Gylfason and Risager (1984) and Branson (1986) found that currency devaluation is contractionary to the economy. Upadhyaya (1999), did not find any significant long-run effect of currency devaluation on aggregate output for 4 out of 6 Asian countries. Bahmani-Oskooee (1998) found that devaluations have no lung-run effect on output in most of the LDCs. Bahmani-Oskooee et al. (2002) investigated the effect of currency depreciation on output in Asian countries. He found that in many Asian countries depreciation is contractionary.

Christopoluos (2004) investigated the effect of currency devaluation on output expansion in 11 Asian countries over the period 1968-1999. He found that, in the long run, the depreciation exerts a negative impact on output growth for five countries while for three countries depreciation improves growth prospects. Upadhyaya (1999) studied the effect of devaluation on output in six developing countries of Asia. The empirical model included monetary, fiscal and external variables. With few exceptions he found that devaluation fails to make any effect on output over any length of time. Whatever the effect on the output, is come from relative prices level, but not from nominal devaluation. Upadhyaya et al. (2004) studied the effect of currency depreciation using panel data and found that while the exchange rate depreciation is expansionary in the short run, it is neutral in the medium and long run. Asif and Rashid (2010) found that there was cointegrated relationship between devaluation and trade balance in Pakistan.

The objectives of this paper are to empirically investigate:

1. Whether the statistical relationship between the real GDP and the real effective exchange rate in Pakistan is uni-directional (real GDP affect/cause real effective exchange rare or real effective exchange rate affect / cause real GDP);
2. Whether the statistical relationship between the real GDP and the real effective exchange rate in Pakistan is bi-directional (real GDP affect/cause real effective exchange rate and real effective exchange rate affect / cause real GDP);
3. The two variables (real GDP and real effective exchange rate) do not influence each other (causality independent).

3. Data Source and Methodological Framework

The study uses annual observations for the period 1980-2009. The main focus of this paper is on economic growth (RGDP) over exchange rate (RER) in the context of Pakistan. The data expressed in real terms, is obtained from various issues of Economic Survey of Pakistan.
We have estimated a simple non-linear RGDP-RER model which has been specified as follows:

$$\log(RGDP) = \alpha_1 + \alpha_2 \log(RER) + \mu \quad (1)$$

Where,

i. RGDP represents Real Gross Domestic Product at Current Prices in Pak Rs. million,
ii. RER represents Real Exchange Rate.

3.1. Econometric Procedure

This paper reviews; the impact of the exchange rate on economic growth in the context of Pakistan economy in the following manners:

- By examining whether a time series have a unit root test; an Augmented Dickey-Fuller (ADF) unit root test has been used.
- By finding the long run relationship among the variable, Engle and Granger Cointegration test has been applied.
- When the variables are found cointegrated, an Error –Correction Model (ECM) has been applied to determine the short run dynamics of the system.

3.1.1. Cointegration Test

The concept of Cointegration was first introduced by Granger (1981) and elaborated further by Engle & Granger (1987), Phillips & Ouliaris (1990) and Johansen (1991), among others. Engle & Granger Cointegration test requires that

- Time-series, say Y_t and X_t, are non-stationary in levels but stationary in first differences i.e., $Y_t \sim I(1)$ and $X_t \sim I(1)$.
- There exists a linear combination between these two series that is stationary at levels i.e., $v_{it} (= Y_t - \hat{\alpha} - \hat{\beta} X_t) \sim I(0)$.

Thus, the first step for Cointegration is to test whether each of the series is stationary or not. If they both are stationary say at first difference i.e. they are *I*(1), then we may go to the second step to verify the long run relationship between them.
Augmented Dickey Fuller (ADF) test is usually applied to test stationarity. It tests the null hypothesis that a series (Y_t) is non-stationary by calculating a t-statistics for $\beta = 0$ in the following equation:

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \gamma_t + \sum_{k=2}^{n} \delta_k \Delta Y_{t-k} + \varepsilon_t$$

Where k = 2, 3, …, n. While α, β, γ and δ are the parameters to be estimated and ε_t is white noise error term.
If the value of the ADF statistic is less than the critical value at the conventional significance level (usually the 5 % significance level) then the series (Y_t) is said to stationary and vice versa. If Y_t is found to be non-stationary then it should be determined whether Y_t is stationary at first differences $\Delta Y_t \sim I(0)$ by repeating the above procedure. If the first difference of the series is stationary then the series (Y_t) may be concluded as integrated of order one i.e. $Y_t \sim$ I(1).

3.1.2. Error Correction Model (ECM)

The ECM combines both short-term and long-term relationships of variables in one equation. The short-term relations are incorporated by the variables in first differences, whereas the long-term relation is represented by the residuals of the estimated cointegration relationship. The parameter of the long-term relationship 'ρ' defines the rate of adjustment to the new equilibrium. If the long-term relationship is valid then 'ρ' have to be negative, and if a departure from the long-term equilibrium appears, the deviation will be reduced in the next period by the value 'ρ'. The reciprocal ($1/\rho$) indicates the length of time for a complete adjustment, i.e. after ($1/\rho$) periods the deviation from the equilibrium is completely eliminated.

3.1.3. Granger Causality Test

If a pair of series is cointegrated then there must be Granger-causality in at least one direction, which reflects the direction of influence between series. Theoretically, if the current or lagged terms of a time series variables, say X_t, determine another time-series variable, say Y_t, then there exists a Granger-causality relationship between X_t and Y_t, in which Y_t is granger caused by X_t.

4. Empirical Results

Economic time-series data are often found to be non-stationary, containing a unit root. If an OLS regression is estimated with non-stationary data and residuals, then the regression is spurious. To overcome this problem the data has to be tested for unit root (i.e. whether it is stationary). If both sets of data are I(1), then if the regression produces an I(0) error term, the equation is said to be cointegrated. Therefore, first we need to check the stationarity of all variables i.e. RGDP and RER used in the study. For this purpose we apply Augmented Dickey-Fuller (ADF) test. Table 1 gives the results of ADF tests.

Table 1. *Augmented Dickey Fuller (ADF) Test on the levels and on the First Difference of the Variables (1980-2009)*

Variables	Level	First Differences	Mackinnon Critical Values for Rejection of Hypothesis of a Unit Root			Decision
			I %	5 %	10 %	
RGDP	1.774	-3.171	-2.621	-1.948	-1.611	Non Stationary at level but stationary at first difference, i.e., *I* (1)
RER	2.412	-3.724	-2.621	-1.948	-1.611	Non Stationary at level but stationary at first difference i.e., *I* (1)

Note: The null hypothesis is that the series is non-stationary, or contains a unit root. The rejection of the null hypothesis is based on MacKinnon (1996) critical values. The lag length are selected based on SIC criteria, this ranges from lag zero to lag five.

The results of Table 1 depicts that, all variables appear to be non-stationary at levels but stationary at first difference. Thus, we may conclude that these variables are integrated of order one i.e. *I* (1). The cointegration test between RGDP-RER is carried out as mentioned below:

4.1. Cointegration Test for RGDP and RER

Cointegration test for the RGDP and RER would help us to clarify if relationship between these two variables exists. Results of regression and ADF test for the residual are presented in Tables 2 and 3 respectively.

Table 2. *Empirical Results of the Model*

Dependent Variable: Log [RGDP]	
Constant	7.422 (0.000)*
Log (RER)	0.771 (0.004)*
AR(1)	0.962 (0.000)*
R-squire	0.989
Adjusted R-squire	0.988
Durbin-Watson Statistics	1.995
F-Statistics	85.197
Probability (F-Statistics)	0.0000*
Number of Observations	30

Note: Values in parentheses show p-statistics. The statistics significant at 1, 5 and 10 % level of significance are indicated by *, ** and ***. J-B test = 2.209[0.331]; Breusch-Godfrey Serial Correlation LM Test = 1.918[0.166]; ARCH test = 2.194[0.173].

Table 3. *Augmented Dickey-Fuller Test for the Residuals*

Estimated Residual Integration	Level	Mackinnon (1996) Critical Values for Rejection of Hypothesis of a Unit Root			Decision	Order of Integration
		1 %	5 %	10 %		
Residual	-6.846	-2.615	-1.947	-1.612	Stationary at level	I (0)

The findings reveal that RGDP has a positive and significant effect on RER. A one percent increases in RER lead to increases RGDP by almost 0.771 percent. The result of Table 3 indicates that the residual is stationary at level that is integrated of order zero. This authenticates our intention that RGDP and RER are indeed cointegrated that is a long run relationship between them holds. In order to ensure stability of long run relationship between RER and RGDP, an Error Correction Model (ECM) has been used. The results are presented in Table 4.

Table 4. *Empirical Findings of Error Correction Model*

Dependent Variable: DLog (RGDP]	
Constant	10.196 (0.000)*
DLog (RER)	0.740 (0.000)*
p	-0.093 (0.042)**
R-squire	0.987
Adjusted R-square	0.986
DW	1.831
F-Statistics	15.734
Probability (F-Statistics)	0.000**
Number of Observations	30

Note: Values in parentheses show t-statistics. The statistics significant at 1, 5 and 10 % level of significance are indicated by *, ** and ***.

The result of Table 4 indicates short-run effect and long-run adjustment impact of RER and RGDP. In the short-run, if there is one percent increases in RER, RGDP increases by almost 0.740 percent. It simply reflects that increased real exchange rate can result in increased real economic growth. While in the long-run, the adjustment parameter (*p*) appears with negative value signifying the long run convergence. The ECM estimation reveals that 9.3% of the disequilibrium in RGDP produced by RER would be adjusted in every year. The conclusion is that there is a stable long run relationship between RGDP and RER.

To confirm the causal relationship between the RGDP and RER, a Granger-Causality test has been applied using lag length up to four periods. The following four hypotheses are tested.

1) RGDP Granger causes RER
2) RER Grange causes RDGP
3) Causality runs in both directions
4) RGDP and RER are independent

The results are provided in Table 5.

Table 5. *Causality Patterns*

Lagged Years	Null Hypothesis	Decision
1	No causality from Log (RGDP) to Log (RER) No causality from Log (RER) to Log (RGDP)	Rejected Rejected
2	No causality from Log (RGDP) to Log (RER) No causality from Log (RER) to Log (RGDP)	Rejected Rejected
3	No causality from Log (RGDP) to Log (RER) No causality from Log (RER) to Log (RGDP)	Rejected Rejected
4	No causality from Log (RGDP) to Log (RER) No causality from Log (RER) to Log (RGDP)	Rejected Rejected

The result shows that the hypothesis that RGDP does not Granger cause RER is rejected. This supports our hypothesis (1). But in the same time, the null hypothesis that RER does not cause

Granger cause RGDP is also rejected. It validates the hypothesis (2). These results, taken together, support the hypothesis (3) and suggest that while RGDP has caused RER, RER also caused RGD; therefore, causality runs in both directions. This finding implies that any investigation of the impact of RER over RGDP should be performed within a simultaneous equation model.

5. Conclusion

The objective of this paper was to find the long and short run effect of currency devaluation on output growth in Pakistan. For this purpose the unit root test and Engel and Granger approach to cointegration were employed for analyzing the data. The results showed that the variables are integrated of first order. The study reveals that there is a significant positive relationship between devaluation and output growth in long as well as short run. Also there exist two way causality relationships between devaluation and output growth.

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