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Examining the Exchange Rate Overshooting Hypothesis in Bangladesh: A Cointegration and Causality Analysis

Sakib B. Amin[1], Muntasir Murshed[2] and Maayesha Tasneem Chowdhury[3]

Following the abandonment of the Bretton Woods Agreement in 1973, the exchange rate has become an important macroeconomic variable that can be linked to the performances of multidimensional sectors within an economy. It has been empirically acknowledged that countries participating in rigorous bilateral and multilateral trade activities are often vulnerable to unanticipated exchange rate movements following which the economy as a whole could encounter adverse impacts. The focal point of this paper is to identify the causal associations between Nominal Exchange Rate (NER) of Bangladesh and its macro fundamentals using relevant annual time series data from 1980 to 2015. A multivariate linear log-log model is used in which NER is expressed as a function of Money Supply (MS), GDP, Domestic Interest Rate (INT) and Local Rate of Inflation (INF). As part of the methodology, Johansen Cointegration test is employed to identify the long run association between the variables considered in the model. In addition, the results from the Vector Error-Correction Model (VECM) approach and Granger Causality test provide the directions of causalities between NER and its determinants. The results reveal that GDP and INT are effective in influencing NER in the long run while MS and INF are found to be ineffective. Thus, in the long run, macroeconomic variables are partially effective in stimulating exchange rate movements in Bangladesh. However, in the short run monetary policy is totally ineffective in influencing NER movements.

Field of Research: Economics

1. Introduction

Exchange Rate (ER) has been acknowledged as one of the most important economic and financial variables in any economy. A possible reason behind ER getting such concern is the fact that it, directly and indirectly, influences several crucial macroeconomic variables which in turn can generate vital impacts on an economy as a whole. Thus, researchers and policymakers worldwide have endeavored themselves in understanding the ER movements in different countries across the world and have evaluated the consequences of such movements in light of both empirical and theoretical frameworks (Alagidede and Ibrahim 2017; Gabaix and Maggiori 2015; Grossman *et al.* 2014; Schaling and Kabundi 2014). It is believed that the ER stability within an economy invariably complements its globalization drives affecting its bilateral and multilateral trade relationships with other nations (Amin and Murshed 2018; Aftab*et*

[1]Assistant Professor, School of Business and Economics, North South University, Dhaka, Bangladesh, Email: sakib.amin@northsouth.edu
[2]Centre for Policy Dialogue, Dhaka, Bangladesh, Email: muntasir.murshed@northsouth.edu
[3]BS in Economics student, School of Business and Economics, North South University, Dhaka, Bangladesh, Email: maayesha2015@gmail.com

al. 2017; Mansfield and Reinhardt 2015; Broda and Romalis 2011; Bhattarai and Armah 2005). As a result, adopting a particular ER regime requires global policymakers to have rich knowledge regarding the factors that may attribute to ER volatility within an economy. Thus, ER volatility and its detrimental impacts on developing and least developed economies, in particular, provide immense motivation for further research in this field.

Keeping the possible adversities attached to ER volatility into consideration, the Exchange Rate Overshooting (ERO) hypothesis was first introduced by Rudi Dornbusch in 1976. This hypothesis, basically concerned about high levels of ER volatility, shows that the impact of such high fluctuations of Nominal Exchange Rate (NER) trigger changes in Money Supply (MS) within the economy (Dornbusch, 1976). There are several reasons that are presumed to stimulate this overshooting of the ER. For instance, it has been argued that because of the existence of speculations and inefficiencies in the foreign exchange markets, ER volatility arises. Similarly, the trade balance of a country is also considered to be responsible for attributing to ERO, which takes place as soon as the country is in a trade deficit with its trading partners. The ERO hypothesis basically developed a simple macroeconomic framework for the study of movements in ER across the globe. In general, the concept of ERO explains the mechanism through which the short-run response of the ER, to an exogenous shock, exceeds its long-run response (Chiliba et al., 2016). The ER is referred to have overshot if, following an unanticipated monetary expansion within the economy, the ER depreciates to a higher level in the short run than what it could have depreciated in the long run equilibrium. Thus, it is crucial to identify the factors that can stimulate ERO in order to design and adopt appropriate policies to safeguard the economy against abrupt ER misalignments.

ERO is considered to be detrimental to economies that pursue export-led growth strategies. Thus, understanding the dynamics adhering ER movements is extremely important in the context of a Least Developed Country (LDC) like Bangladesh having a vast dependence on its export sector whereby a major portion of its GDP is generated from exports of goods and services, particularly readymade garments. Bangladesh has traditionally been following an export-led growth strategy primarily by banking on its readymade garments sector. Thus, volatility in its bilateral ER can severely affect its export competitiveness generating multidimensional impacts on the economy as a whole. For example, a sudden appreciation of the real ER would invariably reduce Bangladesh's export competitiveness leading the country towards possibly facing the Dutch disease problem. Thus, the aim of this paper is to empirically understand the mechanism of ERO in Bangladesh. It specifically focuses on the relationships between the country’s NER and various macroeconomic variables that can influence changes in the NER. To the best of knowledge, there has been no previous paper addressing the causal nexus between ER and its macro fundamentals exclusively in the context of Bangladesh. This paper aims to fill this gap in the empirical literature by testing the ERO hypothesis incorporating annual time series data from 1980 to 2015. In particular, the following questions are specifically addressed in this paper:

1) Is there any long-run association between NER and its macro determinants in context of Bangladesh?

2) What are the directions of causalities running between NER and its determining variables?

The remainder of the paper is as follows. The next section provides an overview of some stylized ER facts in the aspect of Bangladesh. A literature review is followed in section 3 while discussion on the empirical model and the data set is given in section 4. Section 5 deals with the different types of econometric tools used in the paper. Section 6 demonstrates the empirical findings from the test while section 7 provides the concluding remarks.

2. An Overview of Exchange Rates in Bangladesh

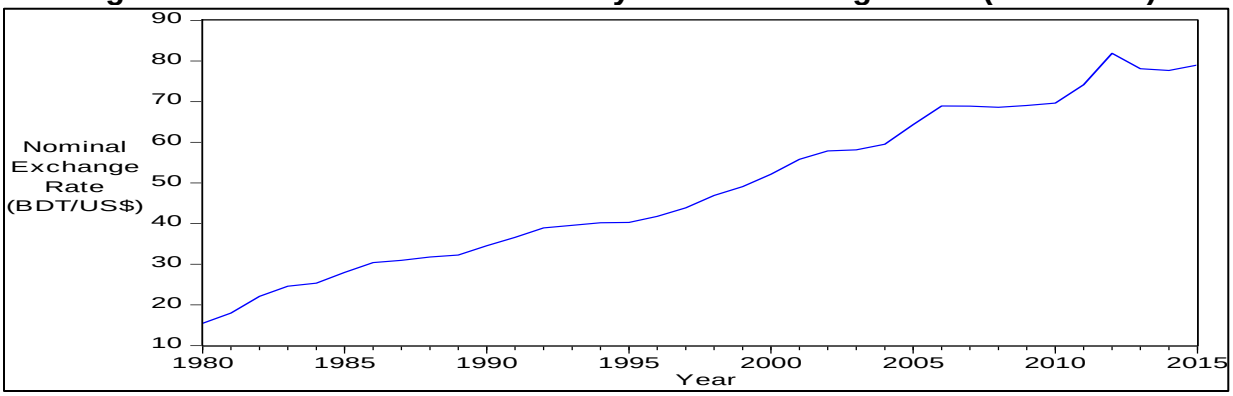
In the past, currencies worldwide were pegged under the price of gold under the Bretton Woods Agreement, which later experienced a collapse in 1973. This was the time when most countries made a transition towards the adoption of a floating ER system from a fixed ER arrangement. ER became one of the utmost important macroeconomic variables following this transition since it is not easy to anticipate ER movements as markets persistently respond to unforeseen news or proceedings. Both nominal and real ER are considered to be the most sensitive indicators of a country's economy, since currencies might appreciate or depreciate, depending on different anticipated or unanticipated situations. This, more often than not, can exert negative impacts not only on a particular economy but also on the world economy as well. In contrast, well-controlled and monitored ER movements can be useful in assisting enterprises and financial institutions in evaluating their returns on investments, especially by reducing their operational risks (Nieh and Wang, 2005).

Likewise all other nations across the world, Bangladesh also historically practiced fixed ER regimes before making the transition into flexible ER arrangements. Following its liberation, the country adopted a fixed ER policy which continued until May 2003 whereby a conversion from fixed to a managed-floating ER regime took place. This transition was executed to meet up the economic demand and to comply with the aid-conditionality put forward by the International Monetary Fund (IMF) that provided highly concessional loans to the country. In order to comply with such conditions, the Bangladesh Bank published a circular stating that the Bangladesh Bank has decided to float its ER and follow a fully market-based ER for Taka from 31st May 2003 onwards (Amin and Murshed 2018). Following this transition in the ER regime, Bangladesh did manage to achieve positive impacts in its macroeconomic development indicators. At present, the country practices as ‘managed-float' ER arrangement framework with the Bangladesh Bank having a strong grip on the ER misalignments.

The country’s NER, measured in terms of Bangladesh taka per US dollars (BDT/US$), had historically depicted an increasing trend with time. Figure 1 provides an idea of how the NER of Bangladesh has projected over the years. The nation recorded its highest NER at 82 BDT/US$ in the year 2012 before experiencing a downward trend that continued till 2014. Provided the fact that Bangladesh had pursued an export-led growth strategy, such rising NER trends ensured that the nation's export competitiveness was not axed as time progressed. This is one of the prime reasons why Bangladesh's

readymade garments sector had experienced a robust boom in the past. During the span of 1980 and 2015, Bangladesh's NER has increased by four times from 15.45 BDT/US$ in 1980 to around 79 BDT/US$ by the end of 2015.

Figure 1: An Overview of the History of NER in Bangladesh (1980-2015)



Source: International Financial Statistics (IFS), 2015, IMF.

3. Literature Review

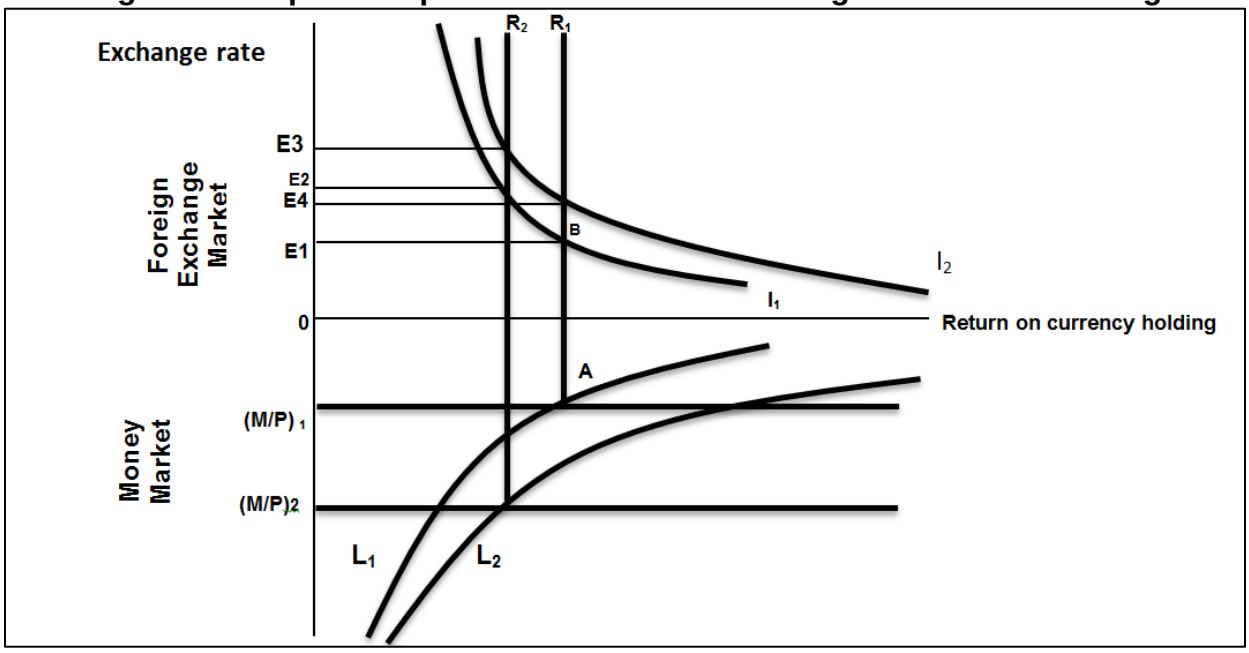
This section is split into two subsections. The first subsection provides a theoretical framework which explains the concept of ERO whereby the ER of a nation depreciates more in the short run than in the long run (steady state). Moving on, the latter subsection sheds light on the existing empirical findings of researchers who have tried to analyze the dynamics of ER movements in the context of different countries all over the globe.

3.1 Theoretical Framework

The ERO hypothesis put forward by Rudi Dornbusch emphasized on relatively more volatility of ER in the short run compared to that in the long run, following employment of either a monetary or fiscal policy action. Figure 1 shows a graphical representation of Dornbusch's ERO (1976) hypothesis. Suppose, in an economy the money and the foreign exchange markets are initially at equilibriums at points A and B respectively. Thus, the initial equilibrium ER is denoted by E_1. Now assuming the government decided to employ a monetary expansion by reducing the rate of interest on borrowing. As a result, both the money demand and the MS in the economy would go up in the short run which can be seen from the shifts in the real money balance schedule (from $M/P_1$to M/P_2) and real money demand schedule (from L_1 to L_2). This would, in turn, stimulate a new equilibrium in the foreign exchange market causing the ER to depreciate in the short run. However, the extent to which the ER appreciates in the short run would depend on whether the change in real aggregate money demand is temporary or permanent. If the change is perceived to be temporary then the ER would depreciate from E_1 to E_2. However, if the change is anticipated to be permanent then the expected rate of return on foreign currency holding would rise which is reflected by the shift in the expected return on foreign currency holding curve (from I_1 to I_2) and as a result, the short-run ER would depreciate further to E_3. Thus, in the short run, a permanent monetary expansion would lead to a depreciation in the ER from E_1 to E_3.

However, in the long run, the price level in the economy would increase causing the real MS balance to return to its original position (M/P_1) and the real money demand schedule would also go back to its initial position (L_1). As a result, in the long run, the foreign exchange market equilibrium position would be restored (point B) but the corresponding long-run real ER would be equal to E_4, which is higher than E_1 but lower than E_2 and E_3. Hence, it can be concluded that following a permanent monetary expansion, there is a possibility of the ERO, in the long run, causing the short-run ER to depreciate more than the long run ER.

Figure 1: Graphical representation of the Exchange Rate Overshooting



Source: Krugman and Obstfeld (2003)

3.2 Empirical Findings

There have been a plethora of studies addressing the cause and effects of fluctuating ER and their possible impacts on the macroeconomic environment of an economy. However, the results found in existing literature does portray ambiguity with respect to the exact mode of ER induced implications on the overall economy of the nations that have faced excessive fluctuations in their respective NER. For instance, Kamin and Rogers (2000) found that devaluation of the local currency of Mexico, depreciating its NER, led to Inflation (INF) and contraction of economic output in the country. Likewise, other findings also recommend in favor of very strong correlation between the INF and ER depreciation (Noer*et al.* 2010; Kamin and Klau 2003; and Choudhri and Hakura 2006). For Kamin and Klau (2003) this correlation project a region-specific dimension whereby it is particularly strong in South America rather than in Asia. Other authors have also opined mixed conclusions about the relationship between INF and ER depreciation (Vinh and Fujita 2007; and Shi 2006). Conversely, Khan *et al.* (2012) found no causality exists in any direction between INF and ER in Pakistan and based on their findings the authors recommended there is no reason to use any ER-oriented policy to constrain the effect of ER movements and their impacts on INF.

The Zimbabwean case is a prime example of ERO which almost crippled the economy. In a study by Mandhiza (2014), the causes of prolonged hyperinflation in Zimbabwe were analyzed in the light of the country's weak currency and rapidly depreciating ER. It was believed that the hyperinflation in Zimbabwe, as well as all the troubles associated with the nation from around 2000-2008, were self-made following the nation's decision to print a large quantity of the Zimbabwean dollars, to honor liberation war veterans, on 14 November 1997 during the "Black Friday". This led to a great meltdown of the Zimbabwean economy, which once stood as the breadbasket of Africa. Although many believed that the hyperinflation was the "number one" enemy in the country, others believed that rapid ER depreciation was the problem attributing to the adversities the economy of Zimbabwe had faced. Statistical data showed that Zimbabwe's INF had reached a local peak of 624% by January 2004, which was the highest rate of INF the world had witnessed in more than a decade. Thus, Mandhiza (2014) probed into the causal relationship between INF and ER depreciation of the Zimbabwean dollar, by adopting the Granger causality test on a monthly dataset that was acquired from 2001 to 2005, which according to the author stood as the core of the hyperinflation in the country. In addition, correlation analyses, Vector Autoregression (VAR) approach, variance decomposition and impulse response functions were also included in the study. The results from the causal investigations suggested that in the short run a unidirectional causal association was present and it ran from ER depreciation to INF. In contrast, the results also confirmed a bidirectional causality between these variables in the long run which implied that the nature of the association between these key macroeconomic indicators exhibits a dynamic relationship with regard to time periods.

Chiliba*et al.* (2016) gathered evidence from Zambia to re-examine the ERO hypothesis following the highly volatile nature of the country's NER. This paper, using monthly NER and monetary fundamentals data from January 2000 to December 2012, adopted the Autoregressive Distributive Lag (ARDL) methodology to investigate the long run associations between NER and the factors that attribute to the rapid changes in the NER of Zambia. In light of the estimations, the study found no evidence of ERO. The results also depicted that there was no long-run equilibrium relationship between the NER and the differentials of macroeconomic fundamentals which include MS, real GDP, Interest Rate (INT) and INF rates. It was implied that macroeconomic fundamentals were statistically insignificant in determining the long run ER fluctuations in Zambia. In another empirical analysis of ERs in Zambia, Mbululu et al. (2013) found that a random walk pattern is not followed by the ER, but that movement is influenced by order flows and noise-trader activities with a minimal role for fundamentals.

In an attempt to comment on the impacts of INT, INF and MS on the ER volatility in Pakistan, Ali *et al.* (2015) empirically analyzed the factors influencing short and long-run ER movements in this South Asian country. The study also focused on finding answers to whether volatility can be controlled by monetary policy and how MS and INTcan attribute to ER volatility in Pakistan. The authors resorted to using Johansen cointegration trace and maximum Eigenvalue tests and Vector Error-Correction Model (VECM) approaches on monthly data for the period ranging from July 2000 to June 2009. Moreover, Granger causality test and impulse response functions have also been applied to verify the effects and responses to certain shocks in the variables. The results primarily suggested that the short run and long run relationships exist between

INF and Pakistan's volatile ER. The results further confirmed that a surge in MS in the economy attributes to INF in Pakistan which in turn triggers its ER volatility. The relevant finding from this paper was that in Pakistan, MS exhibited an inverse relationship with ER volatility which implied that monetary policy was effective in controlling ER fluctuations in Pakistan. In line with these results, the authors recommended the government to raise MS in Pakistan by 20% in order to curb the volatility of the nation's ER. A possible limitation of this paper is in the sense that it does not provide logical reasoning regarding why a rise in MS leads to a fall in the rate of INF in the economy which contradicts the economic theory of a positive association between these macroeconomic variables.

Inyiama and Ekwe (2014) gathered evidence from Nigeria between 1979 and 2010, to investigate whether ER and the INF rate interact or not. Ordinary least squares method was applied to assess their association and impact and also applied Granger Causality technique to evaluate their causality. A co-integration procedure was also applied to detect the long run associations as well. Besides, the Augmented Dickey-Fuller (ADF) unit root tests were also conducted as a pre-requisite to performing the cointegration and causality tests. The results displayed a positive relation between ER and INF, however, the estimation was not statistically significant. This shows that fluctuations in the ER can as well result in a proportionate response in the current inflationary rate. Unidirectional causality was also found to run from INT to INF. According to the study, INT and real GDP have no significant impact on the ER in Nigeria despite the estimated coefficients being negative in both the cases. In similar studies in the context of Nigeria, Akinbobola (2012) examined the dynamic associations between ER, inflationary rate and MS in Nigeria using quarterly data from 1986:Q1 to 2008:Q4. The regression model considered in this paper was estimated using VECM tools and the corresponding results confirmed a negative and significant association between inflationary rate and foreign ER in the long run. In another study, Imimole and Enoma (2011) looked into the probable effects of a drop in the rate of exchange on INF in Nigeria between 1986 and 2008. The conclusions in this paper provided reasoning regarding INF being influenced by real GDP, depreciation in the foreign ER and supply of money.

This study conducted by Babatunde and Shuaibu (2011) estimates a monetary growth model for Nigeria, by investigating the existence of a considerable long-run relationship between MS, capital stock, INF and economic growth between 1975 and 2008. The error-correction mechanism is used in the bounds testing approach to co-integration within an autoregressive distributed lag (ARDL) framework in this paper. The cointegration results implied that real income, INF, MS and gross fixed capital formation in Nigeria are associated in the long run. The estimates also revealed a positive and significant relationship between MS and capital stock, whereas the relationship between INF and growth was found to be negative. Thus, the authors recommended that the government should control the amount of money supplied to the economy effectively so that the INF does not increase to a high level which may impede real income growth.

Nieh and Wang (2005) conducted a study employing the ARDL procedure to understand the ERO hypothesis in the context of Taiwan. The purpose of this study was to look at whether there was a long-run equilibrium relationship between Taiwan's NER and its macroeconomic fundamentals with the ultimate objective of forecasting whether

an anticipated monetary expansion can cause overshooting of the NER. They examined Dornbusch's (1976) sticky-price monetary model to ER determined by using both the conventional Johansen's (1988) maximum likelihood co-integration test and the ARDL Bound test by Pesaran*et al.* (2001) for the monthly data over the period 1986 to 2003. According to the empirical shreds of evidence found, there was no long-run equilibrium relationship between ER and macro fundamentals. However, the result from the ARDL estimations supported the ERO in the short run which corroborated to the dynamic response claimed by Dornbusch (1976).

A possible limitation of the aforementioned studies was that they lacked in theoretical reasoning depicting the connections between ERO and its macro fundamentals. Moreover, the studies are biased in examining these relationships in the context of African countries whereas there is a little emphasis on these relationships in the context of the least developed South Asian nations.

4. Empirical Model and Data Description

Following the concept of ERO put forward by Rudi Dornbusch (1976), arguing ER volatility to be the aftermath of an exogenous shock in the form of a monetary policy action, the authors consider a linear log-log model in this paper in which NER is expressed as a function of MS, controlling for other macro determinants of the NER. The following empirical model is employed in this paper:

$$LNER_t = \beta_0 + \beta_1 (LMS)_t + \beta_2(LGDP)_t + \beta_3(LINT)_t + \beta_4(LINF)_t + \varepsilon_t \text{(i)}$$

where the subscript *t* refers to the particular year of observation. The dependent variable NER refers to the nominal exchange rate measured in terms of Bangladeshi taka per US dollar. As per as the regressors are concerned, MS refers to the broad money which is used as a proxy to denote money supply in the Bangladesh economy and is measured in units of current US dollars; GDP refers to the gross domestic product in terms of current US dollars and it is used in the model to account for the economic growth of Bangladesh; INT denotes the lending rate in Bangladesh which accounts for the rate of return on holding Bangladeshi taka which is theoretically linked to causing changes in the ER; and INF refers to inflation rate measured in percentage terms and it is used in this paper to describe the extent of economic stability in Bangladesh. The justification for inclusion of these aforementioned variables in the model can be retrieved from the theoretical framework provided in section 3.1. All the variables are expressed in their natural logarithm forms. The corresponding NER data in the context of Bangladesh was incorporated from the Economic Review published by the Bangladesh Bank while data of all the other variables were accumulated from the World Development Indicators (2016) data bank of the World Bank. The period of study was from 1980 to 2015.

5. Methodology

5.1 Augmented Dickey-Fuller Test

At first, data of all the variables were tested for a unit root in order to check the stationarity of the variables that were considered in the study. The authors used the Augmented Dickey-Fuller (ADF) unit root test to detect the existence of unit roots, if any, in the data set. Once the variables were found to be stationary, cointegration test was run to find possible linear combinations of the variables which could be considered stationary. Moreover, following confirmation of cointegration between the concerned variables were found to be cointegrated, the authors finally used the Granger Causality tools for determining the direction of causalities between the variables.

It is important to test data, especially time series data, for stationarity since nonstationarity of time series data leads to spurious regression unless there is the existence of at least one cointegrating relationship. Furthermore, the Johansen procedure was applied to test for cointegration, which is known to provide a unified framework for estimation and testing of cointegration relations in the context of VAR error correction models. The authors estimated an Unrestricted Vector of Autocorrelation of the following form for this purpose:

$$\Delta x_t = \alpha + \theta_1 \Delta x_{t-1} + \theta_2 \Delta x_{t-2} + \theta_3 \Delta x_{t-3} + \cdots\cdots + \theta_{k-1} \Delta x_{t-k+1} + \theta_k \Delta x_{t-k} + u_t \quad \text{(ii)}$$

Where Δ is the difference operator; $x_t$is a (n x 1) vector of non-stationary variables (in levels); and $U_t$is the (n x 1) vector of random errors. The matrix θ_k contains the information on the long-run relationship between variables, for instance, if the rank of θ_k = 0, the variables are not cointegrated. On the other hand if rank (usually denoted by r) is equal to 1, there exists one cointegrating vector and finally if $1 < r < n$, there are multiple cointegrating vectors. Johansen and Juselius (1990) derive two tests for cointegration, namely the trace test and the maximum Eigenvalue test. The trace statistic test evaluates the null hypothesis that there are at most r cointegrating vectors whereas the maximum Eigenvalue test, evaluates the null hypothesis that there are exactly r cointegrating vectors in x_t.

5.2 Johansen Test of Cointegration

According to cointegration analysis, when two variables are cointegrated then there exists at least one direction of causality. Granger-causality, introduced by Granger (1969), is one of the important matters that have been much studied in empirical macroeconomics and empirical finance. The presence of nonstationarity can lead to ambiguous or misleading conclusions in the Granger causality tests (Engel and Granger, 1987). Only when the variables are cointegrated, it is possible to deduce that a long run relationship exists between the non-stationary time series.

5.3 Granger Causality Test

When we take y and x as the variables of interest, then the Granger causality test (Granger, 1969) determines whether past values of y add to the explanation of current values of x as provided by information in past values of x itself. If previous changes in y do not help explain current changes in x, then y does not Granger cause x. In a similar way, we can examine if x Ganger causes y just be interchanging them and carrying out this process again. There could be four probable outcomes: (i) x Granger causes y (ii) y Granger causes (iii) Both x and y Granger causes the other and (iv) neither of the variables Granger causes the other.

In this paper, the causality tests among all the concerned variables are conducted. For this the following sets of the equations are estimated:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \cdots\cdots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \cdots\cdots + \beta_l y_{t-l} + u_t \quad \text{(iii)}$$

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \cdots\cdots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \cdots\cdots + \beta_l x_{t-l} + v_t \quad \text{(iv)}$$

We consider the above set of equations for all possible pairs of (*x, y)* series in the group. The reported F-statistics are the Wald statistics for the joint hypothesis $\beta_1 = \beta_2 = \beta_3 = \cdots\cdots = \beta_l = 0$

5.4 Vector Error-Correction Model (VECM)

Engle and Granger (1987) showed that a vector error correction model (VECM) is an appropriate method to model the long-run as well as short-run dynamics among the cointegrated variables. Causality inferences in the multi-variate framework are made by estimating the parameters of the following VECM equations

$$\Delta Y = \alpha + \sum_{i=1}^{m} \beta i \Delta Y_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta X_{t-j} + \sum_{k=1}^{0} \delta \Delta M^s + \sum_{l=1}^{p} \zeta \Delta N + \theta Z_{t-1} + \varepsilon_t \quad \text{(v)}$$

$$\Delta X = a + \sum_{i=1}^{m} b_i \Delta Y + \sum_{j=1}^{n} c_j \Delta X_{t-j} + \sum_{k=1}^{0} d \Delta M^s + \sum_{l=1}^{p} e \Delta N + f Z_{t-1} + \xi_t \quad \text{(vi)}$$

z_{t-1} is the error-correction term which is the lagged residual series of the cointegrating vector. The error-correction term measures the deviations of the series from the long run equilibrium relation. For example, from equation (v), the null hypothesis that X does not Granger-cause Y is rejected if the set of estimated coefficients on the lagged values of X is jointly significant. Furthermore, in those instances where X appears in the cointegrating relationship, the hypothesis is also supported if the coefficient of the lagged error-correction term is significant. Changes in an independent variable may be interpreted as representing the short run causal impact while the error-correction term provides the adjustment of Y and X toward their respective long-run equilibrium. Thus, the VECM representation allows the authors to differentiate between the short- and long-run dynamic relationships. The Chi-Square test statistic is used to determine the short run causalities between pairs of variables in the model.

The authors resorted to using the EViews 7.1 software for carrying out all econometric tests in this study.

6. Empirical Findings

The results achieved upon performing the ADF test of stationarity are given in table 1. According to the result, all of the variables are found to be stationary at their first differenced form, I(1). Thus, the absence of no unit root in the data set allows to test the variables for possible cointegration in the long run.

Table 1: ADF Unit Root Test Results (Lag=8)

Variable	ADF Statistic[a]	Critical Value (95% level)	ADF Statistic[b]	Critical Value (95% level)	Decision on Stationarity
Level I (0)					
LNER	-4.507752	-2.8009838	-4.087370	-3.3710655	Stationary considering both constant and constant and trend
LMS	-0.823677	-2.8009838	-3.174261	-3.3710655	Non-Stationary considering both constant and constant and trend
LGDP	1.967528	-2.8009838	-1.100396	-3.3670698	Non-Stationary considering both constant and constant and trend
LINT	-1.713155	-2.8009838	-2.021494	-3.3670698	Non-Stationary considering both constant and constant and trend
LINF	-3.978951	-2.8009838	-3.895074	-3.3670698	Stationary considering both constant and constant and trend
First Difference I (1)					
LNER	-5.471942	-2.8009838	-5.935106	-3.3710655	Stationary considering both constant and constant and trend
LMS	-4.777730	-2.8035687	-4.752054	-3.3710655	Stationary considering both constant and constant and trend
LGDP	-4.613590	-2.8035687	-5.352243	-3.3710655	Stationary considering both constant and constant and trend
LINT	-4.026575	-2.8035687	-4.094880	-3.3710655	Stationary considering both constant and constant and trend
LINF	-8.344244	-2.8035687	-8.236130	-3.3710655	Stationary considering both constant and constant and trend

Notes: (a) Considering only constant; (b) Considering both constant and trend; Critical Values are given at 95% level.

Following the confirmation of stationarity of the variables, the authors performed Johansen cointegration test to identify the long-run associations between the variables. The Johansen cointegration test results are provided in table 2. The trace test and the maximum Eigenvalue test results show that there is at least one cointegrating equation in the model which implies that the variables are cointegrated, thus answering the research question addressed in this paper.

Table 2: Johansen Test of Cointegration (Lag=2)

Trace Test				
Null	**Alternative**	**Trace Statistic**	**95% Critical Value**	**Conclusion**
r = 0	**r = 1**	76.75860	66.3279455	1 cointegrating equation
r<=1	**r = 2**	46.60215	45.4633235	
r<=2	**r = 3**	22.24008	28.3072165	
Maximum Eigen Value Test				
Null	**Alternative**	**Max-Eigen Statistic**	**95% Critical Value**	**Conclusion**
r = 0	**r = 1**	30.15645	32.1830265	1 cointegrating equation
r<=1	**r = 2**	24.36207	26.205123	
r<=2	**r = 3**	11.05886	20.075039	

Notes: Selection of the lag is based on Schwartz Information Criterion (SIC). EViews 7.1 software automatically selects the most significant lag length based on this criterion.

The Granger causality test results, given in table 3, provided evidence regarding the possible nature of long-run causal associations between the concerned variables.

According to the results, both MS and INF were found to be ineffective in influencing the NER since the corresponding estimated F-Statistics were found to be statistically insignificant at 10% level of significance. However, a bidirectional causal association was found to be existing between ER and GDP while a unidirectional causality was found to be running from INT to ER. This implies that both GDP and INT are effective in influencing NER movements in Bangladesh in the long run. Thus, the overall implication of the Granger causality test is that monetary policy in Bangladesh is partially effective in stimulating NER movements in the long run which reduces the possibility of ERO in the country. The finding suggesting a unidirectional causality running from INT to ER is pretty much in line with the comments made by Kisaka*et al.* (2014) in the context of Kenya.

Table 3: Granger Causality Test (Lag=2)

Null Hypothesis	F Statistic	P-Value	Conclusions
LMS does not Granger Cause LER	1.51588	0.2365	Unidirectional Causality
LER does not Granger Cause LMS	7.51594	0.0023	LER → LMS
LGDP does not Granger Cause LER	5.83828	0.0074	Bidirectional Causality
LER does not Granger Cause LGDP	12.4460	0.0001	LER ↔ LGDP
LINT does not Granger Cause LER	3.27981	0.0520	Unidirectional Causality
LER does not Granger Cause LINT	0.74416	0.4840	LINT → LER
LINF does not Granger Cause LER	0.74436	0.4839	
LER does not Granger Cause LINF	0.36814	0.6952	No Causal Association

Note: The estimated F-Statistics are tested to be statistically significant at 10% level of significance.

The short-run causal relationships between the variables considered in this paper are provided in table 4. According to the VECM results, none of the explanatory variables in this paper is found to be effective in influencing NER movements in the short run as the corresponding estimated chi-square statistics could not be rejected at 10% level of significance. This implies that in the short run monetary policy is totally ineffective in influencing ER movements. The results indicating no causal association between INT and ER corroborates to the findings by Choi and Park (2007) in which the authors pointed out the ineffectiveness of high-interest rates with respect to ER stabilization in Korea, Indonesia and Thailand.

Table 4: VECM Test

Dependent Variable	Null Hypothesis	Chi Square Statistic	P-Value	Conclusions
ER	LMS does not Granger Cause LER	0.5472	0.7606	
MS	LER does not Granger Cause LMS	4.1517	0.1255	No Causal Association
ER	LGDP does not Granger Cause LER	0.9102	0.6344	Unidirectional Causality
GDP	LER does not Granger Cause LGDP	33.5053	0.0000	LER → LGDP
ER	LINT does not Granger Cause LER	2.0450	0.3597	
INT	LER does not Granger Cause LINT	3.1257	0.2095	No Causal Association
ER	LINF does not Granger Cause LER	0.1075	0.9477	Unidirectional Causality
INF	LER does not Granger Cause LINF	11.6018	0.0030	LER → LINF

Note: The estimated Chi Square-Statistics are tested to be statistically significant at 10% level of significance.

The overall findings from the estimated findings highlight the ineffectiveness of MS indirectly influencing ER movements in Bangladesh neither in the short run nor in the long run which is in line with the conclusions made by Chiliba*et al.* (2016) for Zambia and Nieh and Wang (2005) for Taiwan. Conversely, the estimated results are in

contradiction to the concluding remarks drawn by Sharifi-Renani *et al.* (2014) in which the authors found evidence of ERO happening in Iran.

7. Conclusions

ERO in the short run can generate adverse impacts on an economy triggering speculative actions whereby following an overshot ER appreciation, a country's exports can be axed and be replaced by imports. As a result, the country's net exports would experience a decline leading to a fall in its national income as well. Furthermore, highly volatile ER movements can also disrupt the smooth functioning in various sectors within an economy and marginalize the associated growth prospects. Thus, this paper discusses the effects of different macroeconomic indicators that on Bangladesh's NER rate in order to check whether or not they can stimulate overshooting of the nation's ER using short-run and long-run causality tests. The paper incorporated annual time series data from 1980 to 2015 specifically in the context of Bangladesh.

The empirical findings reveal that the possibility of an ERO in Bangladesh, mainly due to a monetary policy action, is negligible due to the monetary policy instruments being ineffective in stimulating changes in the nation's NER in the short run. No causal associations were found to be running from any direction between the nation's NER and it's the macro fundamental considered in the paper. However, in the long run, monetary policy tools are found to be causing movements in Bangladesh's NER since the results reveal a unidirectional causality running from INT to ER. This implies that although monetary policy tools are ineffective in explaining ER movements in the short run, the relationship does not hold in the long run. The concept of INT induced monetary policies affecting ER was also highlighted in the findings by Zettelmeyer (2004) in the context of three open economies: Australia, Canada and New Zealand.

Data constraint was the major limitation faced in this paper which restricted the authors from including more controlled variables in the model. Moreover, due to the same reason, the authors could not use the Real Effective Exchange Rate (REER) instead of the NER which could have provided a new robust dimension to the estimated results. As far as the future scope of research is concerned, the ERO hypothesis in the context of Bangladesh could be reexamined using quarterly and monthly data in order to generate more accurate conclusions. In addition, cross-sectional studies can also be undertaken using different econometric tools, provided availability of relevant data, in order to check for robustness of the estimated results.

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