The Impact of Macroeconomic, Oil Prices and Socio-economic Factors on Exchange Rate in Pakistan: An Auto Regressive Distributed Lag Approach

Suresh Ramakrishnan, Shamaila Butt*, Melati Ahmad Anuar

Faculty of Management, Universiti Teknologi Malaysia, *Email: shamaila.butt87@gmail.com

ABSTRACT

The study examines the linkages among the nominal exchange rate, oil prices, terrorism and three selected macroeconomic variables: Real growth rate, inflation rate and interest rate. The paper employed auto regressive distributed lag to test the long run and short run dynamics over the period 1980-2015 in the context of Pakistan. A novel technique to this research is that we demarcate the relationship among macroeconomic variables, financial variable and socio-economic variable. The findings of the research depict a robust long run relationship among variables. Furthermore, the results showed that the adjustment process is slow and short run adjustment indicating that the discrepancies adjust completely in the same period. Hence, the efficient monetary and fiscal policy should keep into consideration before devising policies that have a greater influence on the variability of exchange rate.

Keywords: Nominal Exchange Rate, Macroeconomic Variables, Terrorism, Auto Regressive Distributed Lag
JEL Classifications: F02, F31, F41

1. INTRODUCTION

Exchange rate is an important factor as its influence on various sectors of businesses, micro and macro level economies and prominently on country's policies that are used for stabilization and making decision. It shows the value of foreign currency in comparison with local currency. Exchange rate is emerging and immense important area of research in the field of finance from last few years Exchange rate is described in a clear manner by flexible price monetary model (FPMM) model, as the general prices of one country relative to another in terms of money. Elements of price are determined by demand and remaining shares of two currencies, it's an elementary logic of financial modeling to the forex rate (Kouri, 1976; Frenkel, 1976; Mussa, 1977; 1979).

Mundell (1962) has emphasized that the economic policies i.e. monetary and fiscal influences foreign exchange during the different regime. The Mundell and Fleming (M–F) model is also known as sticky price model as it has essential assumption that explain the fixed expectation, mobility of capital (imperfect) and the most significant is prices. One of the important criticism raised by the researchers is that the effectiveness and assumption of the

M–F model are not valid. In order to resolve the issues faced by MF-Model, the economist employ FPMM for the determination of exchange rate. FPMM assumes that prices are elastic and continuously change in the expected inflation rate of a country which is led by the deviation in nominal interest rate (Frenkel, 1976; Mussa, 1977; Bilson, 1978).

The study is mainly designed to focus on the factors, which fluctuate the exchange rate of a small open economy like Pakistan. Kemal et al. (2004) highlighted that the fluctuations in demand and supply of forex reserve are the basic factors through which exchange rate of Pakistan economy can be determine in flexible exchange rate. Therefore, the surge of foreign reserves injects in the economy which induced currency appreciated relative to dollar.

There are many studies on determination of exchange rate, such as Galati and Ho (2003), Isard (1983), Branson (1977), Allen and Kenen (1980), Dornbusch and Fischer (1980), Kouri (1976). This study helps the policy maker for introducing the critical macroeconomic factors i.e., growth rate, inflation rate, interest rate. These factors majorly affect the nominal exchange rate (NER) and one of the important financial factor oil prices (OPs) along with

the socio-economic factor i.e., terrorism to investigate the policy implications for the stability of the economy in the perspective of a small economy in Pakistan.

This research study has an important contribution to the literature as to examine the impact of macroeconomic variables i.e. growth rate, inflation rate, interest rate, financial factor; OPs along with the terrorism on exchange rate in the context of Pakistan. In previous studies, there were no linkages between macroeconomic variables and exchange rate or nexus between terrorism, OPs, nor has there been a research study on the topic of terrorism along with macroeconomic variables on exchange rate in the context of Pakistan. This study investigates that how the exchange rate is being influenced by the shocks of these variables. The objectives of this research study are; (i) To examine the long run and short run dynamics among macroeconomic, financial and socio-economic variables with the exchange rate (ii) to investigate that how the exchange rate is influenced by the shocks of these variables; and (iii) to propose the policy implication which is based on the empirical results drawn from this study.

2. LITERATURE REVIEW

This section analyzes three strands of the linkages between the NER with the macroeconomic, financial and socio-economic antecedents. Section 2.1 explains exchange rate and macroeconomic vectors; gross domestic product (GDP) growth rate, inflation rate and interest rate; Section 2.2 reviews the literature on importance of financial factor and explains the relationship between exchange rate and OPs. Section 2.3 discusses the exchange rate and socio-economic factor i.e., terrorism.

2.1. Exchange Rate and Macroeconomic Variables
The extensive literature emphasized the dire need to examine the macroeconomic factors which are influential for the determination of exchange rate. The international financial shocks strike the economies hostilely by means of exchange rate, specifically in the current trade liberalization scenario (Dornbusch, 1976; Frankel, 1979; Bilson, 1981; Fama, 1984; Olivei, 2002; Campa and Goldberg, 2005; Cunado and De Garcia, 2005; Gehrke and Yao, 2013; Chang and Su, 2014; Gehrke and Yaob, 2014; Audzei and Brázdik, 2015).

2.1.1. Exchange rate and GDP growth rate
The relationship between exchange rate and GDP growth rate is extensively studied topic in research. The focus of the most of the researcher is a debate on the volatility of the exchange rate and its influence on the GDP growth rate. In doing so, they use the structural vector autoregressive (VAR) approach and causal relationship for finding the effects of GDP growth rate on the fluctuation of the exchange rate (Blomberg et al., 2005; Mahmood and Ali, 2011). Similarly, (Blomberg et al., 2005) provides a little evidence that economies with large manufacturing industries have more difficulty in currency pegs. Though, it is not clear immediately that which way this possible reverse causality cuts.

Most of the prior empirical studies is now ignored on cross sectional policy regression (Easterly, 2005). An analysis on international growth studies, Easterly (2005) finds that extensive overvaluations stance detrimental effects on growth of economy. The basic purpose behind is not hypothesized explicitly, but utmost accounts bond it to shakiness of the economy of a country (Fischer, 1993). Therefore, the wide-ranging study supports the argument as it is hypothesized that there is significant relationship between GDP growth rate and exchange rate.

2.1.2. Exchange rate and inflation
The pass-through prices influence the exchange rate that is extensively studied in the literature. The researcher identified the larger number of factors that directly or indirectly affect the exchange rate. The large number of factors make it difficult to model this variable (Feenstra, 1989; Olivei, 2002; Campa and Goldberg, 2005). Based on these thoughts, it is evident that the optimality of financial policy requires deviations from price stability, requiring stabilization of the exchange rate (Faia and Iliopoulos, 2010). One the critical factor affecting the exchange rate is inflation in Pakistan (Parveen et al., 2012). Macdonald and Ricci (2004) empirically find that an increase in real commodity prices of 1% is associated with an appreciation of around 0.5% in real effective exchange rate. The importance of exchange rate gives the mixed views in accordance with the determination of inflation rate (Khan et al., 1996). The research study (Khan et al., 1996) elucidates that overall inflation is only determined by money supply, import prices, and real GDP. On the other means, the two-way causality is considerably significant because of these controverting opinions the influence of inflation rate in determination of exchange rate cannot be disregarded. Choudhri and Khan (2002) failed to find out the reason of pass-through of exchange rate in VAR model, while (Hyder and Shah, 2005) find limited indication of exchange rate pass-through as a larger VAR modeling. There is extensive literature of pass through effects of price level on exchange rate or other way around (Feenstra, 1989; Olivei, 2002; Campa and Goldberg, 2005). From literature, it is supposed that there is direct and positive relationship between exchange rate and inflation rate.

2.1.3. Exchange rate and interest rate
Exchange rate importance for financial integrity of an economy is infinite with the introduction of Bretton Wood system since Second World War (Fama, 1984; Bilson, 1981; Frankel, 1979; Dornbusch, 1976). These researches depicts the linkage between exchange rate and interest rate in the modern approach which is asset-market towards exchange rate (Dornbusch, 1976; Frankel, 1979). Engle (2011) articulate that high real interest rates tend to strengthen a currency. One of the important study inferred that volatility in inflation rate and oscillations in exchange rate are interrelated (Ito and Sato, 2006). Benita and Lauterbach (2004) concluded that macroeconomic antecedent has strongly impact on the precariousness of exchange rate compared to the anchor currency. Their research expounded that an increase in the real interest rates make stronger a currency meaning that depreciate the exchange rate (Khattak et al., 2012; Engle, 2011). Thus, we conclude that there is negative relationship between exchange rates and interest rate.

2.2. Exchange Rate and OPs

OP shocks receive important consideration for their presumed role on macroeconomic variables. They are included in several models (Rasche and Tatom, 1981; Bruno and Sachs, 1982; Hamilton, 1988). Furthermore, they have been credited with affecting the natural rate of unemployment (Carruth et al., 1998; Davis and Haltiwanger, 2001; Phelps, 1994. However, the importance of OPs in the matter of exchange rate determination for open economies is significantly articulated (Cunado and De Gracia, 2005). Hutchison (1993) support these economies and explored that the OPs behavior is more considerable in short run as compare to long run.

The variation in the OPs have significant implications on economic activity of the economy (Cunado and De Gracia, 2005; Kim and Loungani, 1992). Such effects are anticipated to be unlike for oil importing and exporting economies. The study revealed the significant negative relationship between the OPs and exchange rate in the short run (Cunado and De Gracia, 2005; Hutchison, 1993). Furthermore, the researchers (Hamilton, 2008; Rodriguez and Sánchez, 2005) explored the impact of fluctuation in OPs on the economy through the rate of exchange. The research studies elaborated the relationship between the exchange rate and OPs of different countries as examined that cointegration and causality exists between exchange rate and OPs (Chaudhuri and Daniel, 1998; Amano and Norden, 1998; Rautava, 2004; Akram, 2004; Dawson, 2007; Al-Mulali et al., 2010; Ito, 2010). This research found that increases in the prices of oil depreciate the country exchange rate (Ghosh, 2011). Thus, it is concluded that exchange rate and OPs have significant relationship.

2.3. Exchange Rate and Terrorism

The research studies have entirely focused on the impact of terrorism on developed economies (Eckstein and Tsiddon, 2004; Enders and Sander, 1996). Nowadays, the developing countries are facing devastating circumstances by terrorist attacks as well as reactive to external shocks. It's regular hit news across the globe about suicide attacks, death counts and incidents, which is with greater magnitude in Pakistan as compared to Greece, Spain, Israel, Turkey and USA.

The dynamic contributions of forerunners explained the responsiveness of terrorism (Schelling, 1960; Boulding, 1962; Landes, 1978). Later, contemporary studies are developed by the researchers (Kirk, 1983; Atkinson et al., 1987; Im et al., 1987; Lee, 1988; Cauley and Im, 1988; Lapan and Sandler; 1988; Islam and Shahin, 1989; Shahin and Islam, 1992; Lapan and Sandler, 1993; Enders and Sandler, 1993; 1995; 2000; 2002; Arce and Sandler, 2003).

In addition, the other supported studies also discussed the influence of terrorism on the economy (Frey, 1987; 2004; Frey and Luechinger, 2002; 2003; Schneider, 2004). In Middle East and Africa, the resilient effects of terrorist attacks are dreadful. From last couple of years, terrorism has reached on its peak among five countries including Iraq, Afghanistan, Nigeria, Pakistan and Syria. In the past few years, the terrorism caused a predominant number of casualties.

The 2014, only, caused 32658 casualties that is 10-fold higher than that of 2000 and still the 2015 data shows that it is still increasing with alarming situation (Global Terrorism Index, 2015)[1]. Unfortunately, terrorist activities have an impact on economy to microeconomic and macroeconomic repercussion (Enders and Sandler, 1996).

Further, civil war may be the reason of spillover cost of capital flight (Collier, 2003) and detrimental shock on airlines and tourism (Drakos, 2004; Ito and Lee, 2005). The 9/11 event had the estimated cost ranging between $80 and $90 billion in the capacity of wages loss, unemployment compensation and lesson commerce activities (Kunreuther et al., 2003). Therefore, its the paramount need to know about costs levied on people by terrorist acts[2].

In order to evaluate the instability and violent extremism impact in Pakistan during a decade, the assessment for fiscal year 2015 has been organized in discussion with related Ministries/Provincial government/Departments/Autonomous bodies, etc. Table 1 illustrated the summary of losses due to terrorist attacks.

In Pakistan, the direct and indirect cost to be incurred during the FY 2001 to FY 2015 as Rs. 8702.75 billion or in US$ 106.98 billion. The data is exhibited in Table 2.

A prominent contribution of Chaudhuri and Sensarma (2001), demonstrate that the 9/11 terrorist attack on world trade center have considerable impact on the foreign exchange markets, financial markets and commodity markets with many other macroeconomic factors around the world. Thus, the result explicated that the terrorist attacks greater influence on exchange rate as compare to stock and commodity prices. The study noted that exchange rate reacts differently as currency devalued in comparison with developing and developed economies.

With this background of existing literature, the study emphasized the possibility of relationship between macroeconomic variables, financial and social antecedent with NER. The literature of this research alloys the three strands as macroeconomic variables (growth rate, inflation rate and interest rate), OPs and terrorism with exchange rate. These associations are investigated in the context of Pakistan that has so far not acknowledged much consideration.

3. DESCRIPTION OF DATA

The annual data set is used for analysis of the following variables were identified: NER, real growth rate (RGR), inflation rate (INF), interest rate (INT), OP and terrorism (TERR). The data used over the period of 1980-2015 in the context of Pakistan.

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1   Global Terrorism Index, 2015 is formed by the Institute for Economics and Peace. It is constructed from the Global Terrorism Database, which is composed and organized for the Study of Terrorism and Responses by National Consortium to terrorism.

2   Economic methodology refers that the individuals have preferences based on normative nature to take account of distinct policies (Brennan and Buchanan, 1985). During cold war epoch, (Hobijin, 2002) allude the military expenditure as a reference point and conclude the costs of security of homeland will be limited and peace dividend of 1990 will not be evanesce.

These data series are in percentage (%) except crude OP which is in per barrel dollar. Thus, this series transformed into log as per requirement. The descriptions of data are summarized in following Table 3.

4. ESTIMATION STRATEGY

4.1. Methodology

To estimate the model, there are four steps: Firstly, as time series analysis observes non-stationary path. Firstly, this study uses

Table 1: Summary of terrorist attack losses (US$ billion)

Organization	Years		Total
	2013-14	2014-15*	
Exports	0.53	0.73	1.26
Compensation to affectees	0.04	0.01	0.05
Physical infrastructure	0.42	0.5	0.92
Foreign investment	2.01	0.09	2.10
Privatization	0.00	0.00	0.00
Industrial output	0.03	0.02	0.05
Tax collection	2.52	2.00	4.52
Cost of uncertainty	0.07	0.00	0.07
Expenditure over run	0.29	0.62	0.91
Others	0.72	0.55	1.27
Total losses	6.63	4.53	11.16

*Estimated based on 9 months' actual data (July-March). Source: M/o Finance, M/o Interior, M/o Foreign Affairs, Joint Ministerial Group

Table 2: Estimated losses (2001-2015)

Years	$ Billion	Rs. Billion	% Change
2001-02	2.67	163.90	-
2002-03	2.75	160.80	3.0
2003-04	2.93	168.80	6.7
2004-05	3.41	202.40	16.3
2005-06	3.99	238.60	16.9
2006-07	4.67	283.20	17.2
2007-08	6.94	434.10	48.6
2008-09	9.18	720.60	32.3
2009-10	13.56	1136.40	47.7
2010-11	23.77	2037.33	75.3
2011-12	11.98	1052.77	−49.6
2012-13	9.97	964.24	−16.8
2013-14	6.63	681.68	−33.5
2014-15*	4.53	457.93	−31.7
Total	106.98	8702.75	

*Estimated based on 9 months' actual data. Source: MoF, M/o Interior, M/o Foreign Affairs Joint Ministerial Group

descriptive statistics to summarize the nature of data. Secondly, to check the stationary of the series a unit root test as augmented Dickey and Fuller (ADF) is applied for order of integration. Thirdly, an auto regressive distributed lag (ARDL) bound test are conducted to confirms that the long run relationships either exists between the variables or not. The aim is to confirm that the variables are not I(2) to evade the spurious results. From this point the study cannot construe the F statistics value in the existence of the series integrated of order two (Pesaran et al., 2001). In line with ARDL approach, an error term is used to determine the short run dynamics of variables towards exchange rate. Lastly, impulse response functions (IRFs) is employed to trace out the influence of the shocks for future.

4.1.1. Unit root test

This research study employed the unit root test under consideration as the time series data are trended (non-stationary). So, two tests i.e., ADF (Dickey and Fuller, 1981) and Dickey-Fuller generalized least square (DF-GLS) de-trending test advocated (Elliot et al., 1996). These tests have been used for checking the stationary of the series. Nevertheless, there are manifold limitations in practicing these tests though in the unit root determinations these tests are extensively used (Khan and Qayyum, 2008).

4.1.2. ARDL bounds test

ARDL approach primarily developed and familiarize by the researchers (Pesaran and Shin, 1995; 1998; Pesaran and Pesaran, 1997; Pesaran et al., 1996; 2001). This technique has three definite advantages in comparison with the traditional and previous cointegration approaches. Firstly, the ARDL does not require that all the series must have same order of integration although which is needed for Johansen co-integration and Engle Granger residual co-integration. Secondly, the ARDL test is comparatively more efficient in the matter of limited and small sample sizes of data. The last and important advantage is that the study acquired unbiased of the log run model estimates by employing ARDL technique. When the variables understudy is endogenous, the bound testing technique is used which usually provides the long run unbiased estimates and t-statistics (Odhiambo, 2008; Narayan, 2005). This approach simultaneously contributes the long run and short run dynamics for empirical testing. ARDL technique provides an efficient path independently to observe the causal long run and short run relationship (Bentzen and Engsted, 2001). If there is an evidence of existence of long run cointegration among the variables, then the next step is to estimate the coefficients and their

Table 3: Variables and their definitions

Variable	Symbol	Definition
Nominal exchange rate	NER	Nominal exchange rate: The nominal exchange rate of local currency (PKR) to US dollar ($) (Source: OANDA)
Real growth rate	RGR	Real growth rate: RGR is defined as all the goods manufactured and services provided during the period (annual %) adjusted for inflation (Source: WDI)
Inflation rate	INF	Inflation rate: Percentage change in consumer price index as the persistent increase in the general price level of the country (Source: WDI)
Interest rate	INT	Interest rate: Call money rate is the short-term loan which has given to brokers by bank who further lend money to investors. CMR used as proxy variable for interest rate (Source: IFS)
Oil prices	OP	Crude oil prices: Crude oil (petroleum), simple average of three spot prices; dated brent, west texas intermediate, and the Dubai fateh, US dollars per barrel (Source; IMF world Economic Outlook [WEO])
Terrorism	TERR	Terrorism: The military expenditure as (%) of GDP, as proxy variable for terrorism (Source: WDI)

IFS: International financial statistics, WDI: World Development Indicators, IMF: International monetary fund, CMR: Call money rate, GDP: Gross domestic product

significance level. After the optimal lag selection criteria, long run model as ARDL and error correction mechanism.

4.1.3. IRF

The estimation of VAR, the term error or stochastic shows shocks or innovations. These shocks are referring as impulses and system is described as IRF. After estimating the VAR model, it is not possible to explain individual coefficients. The effects of shocks influence the economy for several years which is trace out through impulses. In VAR system, the endogenous variable response to shock is addressed by the IRF.

5. EMPIRICAL ANALYSIS

The study reports three strands of literature as macroeconomic variables, financial variable and socio-economic variable. Accordingly, the research constructs to examine the long run and short run dynamics between NER, RGR, INF, and INT, OP and TERR.

5.1. Descriptive Statistics

Table 4 depicts that mean (47.55) and standard deviation (29.51) of NER is high as compare to other variables. Furthermore, the table also reported that the variables i.e., NER, RGR, inflation rate and OPs have positive skewness. Whereas the two variables have negative skewness represents as interest rate and terrorism. Finally, kurtosis showed the peakness of data, as inflation rate and interest rate have high values as compare to other series as 3.84

Table 4: Summary statistics

Statistics	NER	RGR	INF	INT	LOP	TERR
Mean	47.55	4.85	8.46	8.76	1.52	5.21
Median	45.00	4.80	7.85	8.95	1.45	5.50
Maximum	102.70	10.20	20.30	12.60	2.02	7.30
Minimum	9.90	1.00	2.90	2.10	1.12	3.30
Standard deviation	29.51	2.15	3.77	2.48	0.29	1.41
Skewness	0.43	0.25	0.73	−0.65	0.54	−0.05
Kurtosis	1.96	2.58	3.84	3.44	1.89	1.43

NER: Nominal exchange rate, RGR: Real growth rate, INF: Inflation, INT: Interest rate, LOP: Oil prices, TERR: Terrorism

and 3.44. The table supporting the argument that the NER is more volatile than the volatility in macroeconomic variables, financial and socio economic indicator.

5.2. Graphical Analysis of Non-stationary Series

Figure 1 is a plot of the non-stationary time series data i.e. NER, RGR, inflation (INF), interest rate (INT), oil prices (LOP) and terrorism (TERR). The leading step for scrutinizing time series data is the graphically plotting of the data. Figure 1 considers that these series have a unit root, as its mean, variance and covariance is time varying, as after taking the unit root test the series become stationary.

5.3. Unit Root Tests

Table 5 illustrates the results of ADF and DF-GLS tests that at level all the series are non-stationary. Thus, the tests applied to the variables on the first differenced of the data. Hence the computed value (=t) or test statistic is more negative than 1% or 5% critical value, the study reject null hypothesis Therefore, it is concluded that all the series are integrated in first difference.

5.4. Graphical Analysis of Differenced Stationary Series

Thus, mean variance and covariance of the series remains equal then it is stationary. As Figure 2 exhibit an understanding with the reference of series stationarity as macroeconomic vector, financial and socio-economic variable is tending to move around its mean. If the series are matching up both figures as non-stationary and differenced series, the study reveals that Figure 2 gives a clear glimpse of the stationarity of data.

Summarizing the results of ADF and DF-GLS test, the estimation indicates that all the variables have unit root at level but after first differenced the series became stationary, thus the order of integration is I(1).

5.5. ARDL Bounds Test

The next step is estimation of ARDL approach to find out long run co-integration and short run interactions among the variables. In model, AIC is designated as a leading indicator to make it certain

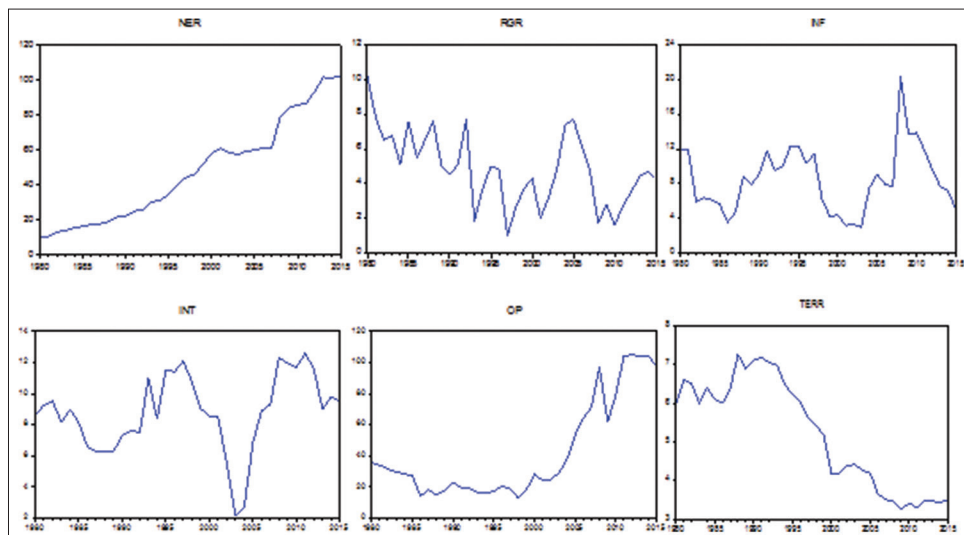**Figure 1:** Non-stationary series

Table 5: Unit root test of series (1980-2015)

Variable	Test for unit root in	t-statistics	1% Critical values	5% Critical values
NER	ADF test			
	At level	−0.69	−3.63	−2.95
	First difference	−4.28	−3.64	−2.95
	DF-GLS test			
	At level	1.83	−2.63	−1.95
	First difference	−4.7	−2.63	−1.95
RGR	ADF test			
	At level	−3.06	−3.63	−2.65
	First difference	−5.44	−3.64	−2.95
	DF-GLS test			
	At level	−2.27	−2.63	−1.95
	First difference	−6.24	−2.63	−1.95
INF	ADF test			
	At level	−2.36	−3.63	−2.95
	First difference	−4.74	−3.64	−2.95
	DF-GLS test			
	At level	−2.59	−2.63	−1.95
	First difference	−7.16	−2.63	−1.95
INT	ADF test			
	At level	−0.55	−2.63	−1.95
	First difference	−3.67	−2.63	−1.95
	DF-GLS test			
	At level	−2.13	−2.63	−1.95
	First difference	−5.50	−2.63	−1.95
OP	ADF test			
	At level	−0.15	−3.63	−2.94
	First difference	−6.73	−3.64	−2.95
	DF-GLS test			
	At level	−0.25	−2.63	−1.95
	First difference	−6.59	−2.63	−1.95
TERR	ADF test			
	At level	−0.52	−3.63	−2.95
	First difference	−4.12	−3.64	−2.95
	DF-GLS test			
	At level	−0.17	−2.63	−1.95
	First difference	−3.97	−2.63	−1.95

ADF: Augmented Dickey and Fuller, DF-GLS: Dickey-Fuller generalized least square, NER: Nominal exchange rate, RGR: Real growth rate, INF: Inflation, INT: Interest rate, OP: Oil prices, TERR: Terrorism

that there is no possibility for autocorrelation. Thus, the maximum optimal number of lags for principle regressor and dependent variable is 3. As well as, intercept is included as a fixed regressor.

Furthermore, the dynamic regressors are in log form except the fixed regressor (intercept). The value of R^2 is less than the D-W stats, thus model is best fitted. Table 6 summarizes the results log variables coefficients of ARDL model. After estimating model, the coefficients as first lagged value of Log (NER), Log (RGR) and Log (TERR), Log (INF), third lagged value of Log (INT) and Log (OP) are significant as P value is <5%. The P value of F-statistic strongly recommends that there is no autocorrelation evidence in the residuals of model.

$$H_0: \delta_1 = 0, \delta_2 = 0, \delta_3 = 0, \delta_4 = 0, \delta_5 = 0, \delta_6 = 0$$

(long run relationship does not exist)

$$H_1: \delta_1 \neq 0, \delta_2 \neq 0, \delta_3 \neq 0, \delta_4 \neq 0, \delta_5 \neq 0, \delta_6 \neq 0$$

(long run relationship exists)

In Figure 3, it seems that the top twenty results shown for choosing model selection criteria summary. The first model has a desirable lag length as (3, 0, 3, 3, 3, and 1). Therefore, this model is finally selected in ARDL approach.

Table 7 illustrates that Coint.Eq (−1) shows the coefficient value has a desirable sign i.e., negative (−0.05), however, it is insignificant at 5% level. Therefore, the speed of adjustment of the model towards equilibrium is questionable.

It is noticed in Table 8 that the long run relationship exists amongst variables, as the NER is the dependent variable then calculated value of F-statistic (5.73) is greater than the critical value of upper bound at 5% (3.79). We reject null hypothesis in favor of alternate that there is an evidence of long run relationship.

Figure 2: Differenced stationary series
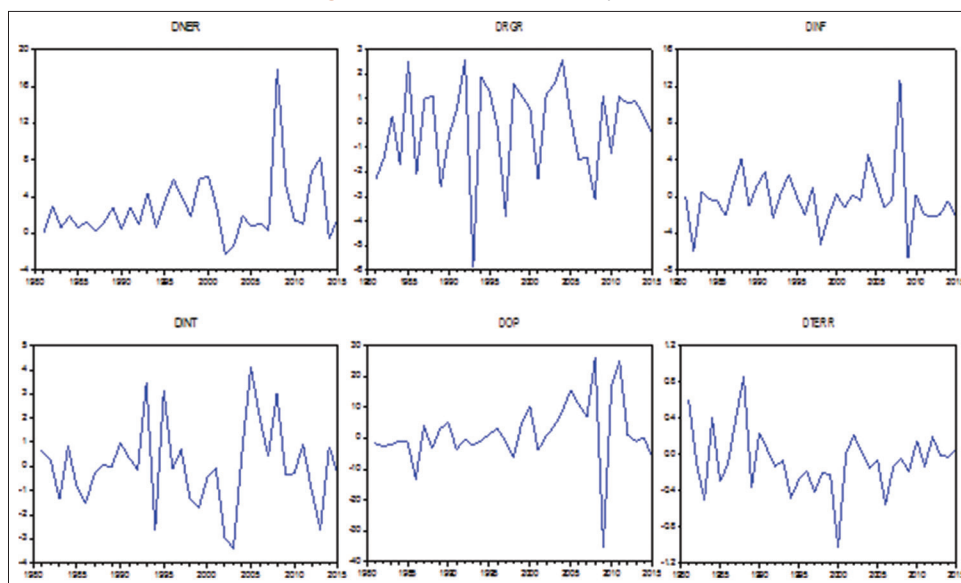
We conclude that, firstly, there is a long run relationship between NER, macroeconomic variables and socio-economic variable. Secondly, after estimating short run dynamics of ARDL model the results shows that short-run equilibrium coefficient is negative which is favorable but insignificant at 5% critical value. This coefficient explains the short run equilibrium at which the disequilibrium of the system of previous period is being corrected. The coefficient of error term (−0.05) is negative and statistically insignificant at more than 5%, level of significance which implies that 5% annually disequilibrium adjusts in the current period completely.

5.6. IRF

Figure 4 depicts that the OPs shock effect the economy. If one standard deviation of the shock affects the variables, then response of OPs shock shake the economy badly. The variables such as RGR, INF and INT are going to be stable but not completely recovered. In contrast, NER and terrorism neither is stable nor is dying out quickly. Finally, if the one standard deviation shock given to the other endogenous variables then response of terrorism to other factors illustrates that after 5 years the variables become steady and stable. Hence, it shows that how these shocks affect all the variables with their own and other variables which upset economy and mitigate the effects in VAR system.

6. CONCLUSION AND POLICY IMPLICATIONS

In a nutshell, the study hypothesis is vindicated by empirical findings. The short run adjustment results are established by using ARDL model. The random error value is negative but insignificant as indicates that error is corrected in the current period. Likewise, it also explains that variables have capacity to recover the shock in the tenth period. In the whole analysis, the study construe that all the selected macroeconomic variables, financial and a socio-economic variable contains long run association and determine the exchange rate significantly. In Pakistan, the production lean
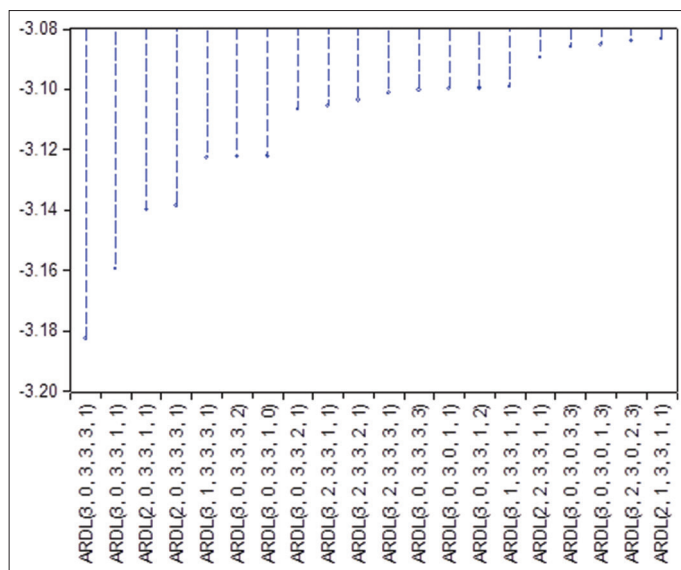
Figure 3: Akaike information criteria (top 20 models)

Table 6: Estimated long run coefficients auto regressive distributed lag coefficients

Variable	Coefficient	Standard error	t-statistics	P*
LOG (NER (−1))	0.39	0.18	2.16	0.04
LOG (NER (−2))	0.33	0.21	1.59	0.13
LOG (NER (−3))	0.21	0.17	1.24	0.23
LOG (INF)	0.08	0.03	2.61	0.02
LOG (INT)	0.01	0.04	0.24	0.80
LOG (INT (−1))	0.06	0.05	1.18	0.25
LOG (INT (−2))	−0.00	0.05	−0.10	0.91
LOG (INT (−3))	0.15	0.05	2.89	0.01
LOG (OP)	−0.01	0.05	−0.30	0.76
LOG (OP (−1))	0.01	0.04	0.26	0.79
LOG (OP (−2))	0.01	0.04	0.21	0.83
LOG (OP (−3))	−0.09	0.04	−2.10	0.05
LOG (RGR)	−0.01	0.03	−0.54	0.59
LOG (RGR (−1))	0.079	0.03	2.61	0.02
LOG (RGR (−2))	0.00	0.02	0.01	0.98
LOG (RGR (−3))	0.04	0.02	1.43	0.17
LOG (TERR)	−0.49	0.18	−2.60	0.02
LOG (TERR (−1))	0.31	0.18	1.68	0.11
C	0.07	0.42	0.164	0.87
R²	0.99	Mean dependent variable		3.75
Adjusted R²	0.99	Standard deviation dependent variable		0.63
F-statistic	399.42	Durbin–Watson statistics		2.27
P (F-statistic)	0			

*P values and any subsequent tests do not account for model selection. NER: Nominal exchange rate, RGR: Real growth rate, INF: Inflation, INT: Interest rate, OP: Oil prices, TERR: Terrorism

Table 7: ARDL cointegration

| Variable	Coefficient	Standard error	t-statistic	P
DLOG (NER (−1))	−0.55	0.168	−3.26	0.00
DLOG (NER (−2))	−0.21	0.17	−1.24	0.23
D (INF)	0.08	0.03	2.61	0.02
DLOG (INT)	0.01	0.04	0.24	0.80
DLOG (INT (−1))	0.00	0.05	0.10	0.91
DLOG (INT (−2))	−0.15	0.05	−2.89	0.01
DLOG (OP)	−0.01	0.05	−0.30	0.76
DLOG (OP (−1))	−0.01	0.04	−0.21	0.83
DLOG (OP (−2))	0.09	0.04	2.10	0.05
DLOG (RGR)	−0.01	0.03	−0.54	0.59
DLOG (RGR (−1))	−0.00	0.02	−0.01	0.98
DLOG (RGR (−2))	−0.04	0.02	−1.43	0.17
DLOG (TERR)	−0.49	0.18	−2.60	0.02
Cointegration Equation (−1)	−0.05	0.04	−1.17	0.25

ARDL: Auto regressive distributed lag, NER: Nominal exchange rate, RGR: Real growth rate, INF: Inflation, INT: Interest rate, OP: Oil prices, TERR: Terrorism

Table 8: ARDL bound test

Test statistic	Value	k
F-statistic	5.73	5
Critical value bounds		
Significance	I0 bound	I1 bound
10%	2.26	3.35
5%	2.62	3.79
2.50%	2.96	4.18
1%	3.41	4.68

ARDL: Auto regressive distributed lag

Figure 4: Impulse response function
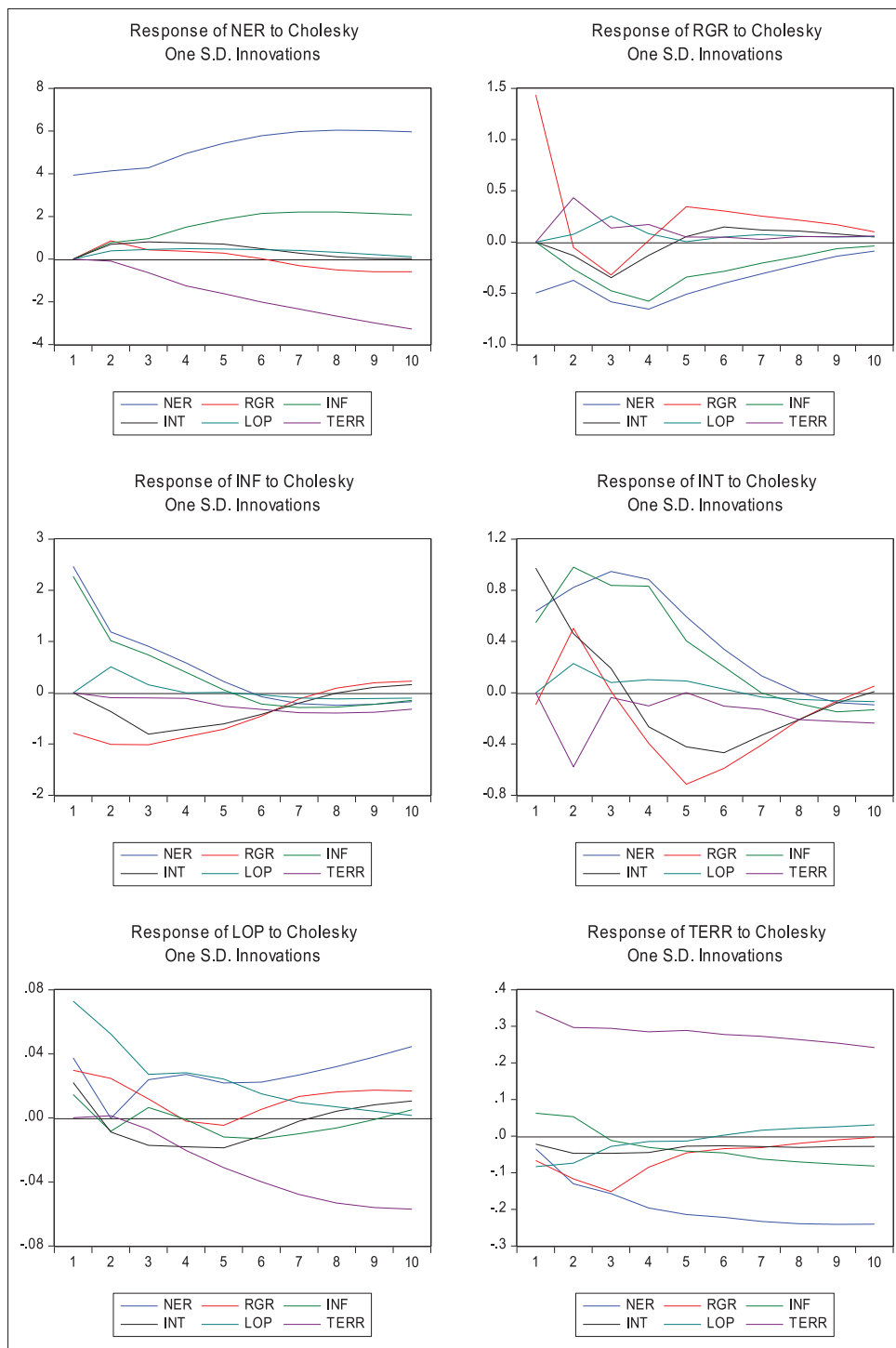
on agriculture which expedites the exports of surplus goods but precarious upsurge of imported bills in capital goods and other factors such as energy crises, floods, war against terrorism and long March/Dharna impacted the infrastructure, further agriculture sector of economy may depreciate the currency as 4.4% or appreciate the exchange rate as 98.82 (PKR) to 103.19 (PKR) per dollar (Economic Survey of Pakistan, 2014-2015). So, there is a positive relationship between inflation rate which induced the exchange rate appreciate (Campa and Goldberg, 2005). Moreover, an increase in interest rate tends to strengthen the currency and has negative relationship with the NER (Engle, 2011). Besides, there is

negative and significant connection among oil process, exchange rate other variables (Edwards, 1985; Amano and Norden, 1998). The exception in the case of terrorism as has positive impact on NER supported by Chaudhuri and Sensarma (2001).

In the light of our empirical findings we suggest that macroeconomic stability is good for long run growth. Thus, the government must develop policies which is supported by supply side increase in the level of exports as exchange rate influence positively as well as OPs induced to appreciate the exchange rate. The currency depreciation can impact on exports positively as domestic goods

would be offered in external market at cheap prices. The proposed argument for policy makers is that as to adopt the contra-dictionary monetary policy to control the inflation. It stabilizes the exchange rate of a country. Pakistan is facing energy dilemma which is evidence as it is an oil importing country which creates circular debt in the economy. The regulating authorities must lessen the usage of crude oil to decline the spending and tried to figure out the substitutes for conservancy of energy. The governing bodies and decision makers should device some solid measures to curtail the expenditures against terrorism and try to stable the security reforms in the country. In this scenario, serious government policies and efforts are needed to take the country out of the dilemma and boost the foreign direct investment in Pakistan. The real limitation of this study is not the ease of use of availability of data. As the monetary aggregates are constantly available but the real sector data is never being consistent in monthly and quarterly series in Pakistan. Secondly, the most considerable variable as military expenditure which has been taken against terrorism despite the cost of war data that consists insufficient number of observation from 2001 to 2015. Notably, in future study we can take daily, monthly, semiannually data for forex exchange rate. Moreover, the Granger Causality technique provides more comprehensive results for determination of exchange rate as empirically find out the cause and effect relationship.

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