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Forecasting of VAR and ARIMA Based Exchange Rate of Bangladesh

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Abstract

This paper concentrates technical analysis to address stochastic and deterministic approach to forecast exchange rate of Bangladesh. Volatility clustering exchange rate of Bangladesh is market driven based on managed float. Vector auto regression (VAR) approach is used to determine the exchange rate in order to form rational expectation regarding exchange rate of Bangladesh. Technical analyses ranging from unit root to VAR have been used to forecast the monthly average exchange rate following new convention. SWAP and forward exchange rate will be determined taking into account absolute and comparative advantage and rational expectation. I have also applied auto regressive integrated moving average (ARIMA) model to forecast the exchange rate. Non seasonality in ARIMA predicted stable exchange rate for next six months (July-December, 2012), which is mostly close to actual rate. This exercise will help to forming rational expectation about exchange rate forecast from quantitative point of view.

Keywords: Central bank and policies**,** Exchange rate and forecasting and model application.

JEL classification: E58, F31 and F47

1. Introduction

Considering technical analysis like VAR and ARIMA investor can rationally forecast the exchange rate. Each observed variables scrupulous attention can establish the long run equilibrium relationship of exchange rate deviation. Technically robust forecasted exchange rate from the policy perspective will enhance the export and remittances with a balance in import. Proper exchange will stabilize the inflation with higher GDP growth. This paper observes that exchange rate in the short run may be deterministic which becoming stochastic in the long run. Apart from technical analysis further investigation addressing trade weighted inflation adjusted partner countries currency basket and all capital flows of balance of payments (BOP) may produce better exchange rate in Bangladesh.

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Monzur and Mansur (2009) examine the exchange rate policy in Bangladesh for the period 2000-08. Regime classification of the paper suggests that Bangladesh maintained a de facto managed floating regime by intervening in the foreign exchange market on a regular basis. This is at odds with the Bangladesh Bank's claim of maintaining de jure floating regime since end-May 2003. A high exchange rate pass-through is observed along with high market pressure during the period of expansionary monetary policy. Given the thin foreign exchange market and high pass-through effects, it appears difficult for Bangladesh to maintain a freely floating regime.

As the government has successfully achieved the macroeconomic stability, agent may rationally work for arriving and adjusting future time path of exchange rate using VAR and ARIMA. In the monetary frontier, the Nationalised Commercial Banks (NCBs) are hesitant to lend because of uncertainty, which resulting higher rate. Consequently the economy is experiencing with excess liquidity. On the demand side, the current account surplus attributed higher growth in Taka currency, advocating interest rates and money supply balancing. Excess liquidity can be absorbed through Reverse Repo and Bangladesh Bank Bill for maintaining balance in interest rate and exchange rate. It is hoped that collective actions taken by the banks and BB will deal the agency problems related to exchange rate smoothing investment and mobilizing savings. Operationally, this is how rotten apples can be segregated from good ones (A.K.N. Ahmed, former Governor, IBB Journal, Dec.1997).

Organization of the paper

Literature review is articulated in section-I. Section-II explains methodology. Section-III deals with VAR model variables from macroeconomic perspective in brief. Analyzing the VAR model and exchange rate forecasting are described in section-IV. Forecasting of volatility clustering exchange rate using ARIMA is depicted in Section-V. Conclusion is represented in Section-VI.

Section-I

Literature Review

Luetkepohl (2011) suggests that multivariate simultaneous equations models were used extensively for macro econometric analysis when Sims (1980) describes VAR models as alternatives. The model typically treats all variables as a priori endogenous. Sims' critique that the exogeneity assumptions for some of the variables in simultaneous equations models are ad hoc and often not backed by fully developed theories. Restrictions, including exogeneity of some of the variables, may be imposed on VAR model based on statistical procedures. VAR models are natural tools for forecasting. Their setup is such that current values of a set of variables are partly explained by past values of the variables involved. They can also be used for economic analysis, however, because they describe the joint generation mechanism of the variables involved. Structural VAR analysis attempts to investigate structural economic hypotheses with the help of VAR models. Traditionally VAR models are designed for stationary variables without time trends. Trending behavior can be captured by including deterministic polynomial terms. In the 1980s the discoveries of the importance of stochastic trends in economic variables and the development of the concept of co-integration by Engle and Granger (1987) have shown that stochastic trends can also be captured by VAR model. If there are trends in some of the variables it may be desirable to separate the long-run relations from the short-run dynamics of the generation process of a set of variables. Vector error correction models offer a convenient framework for separating long run and short-run components of the data generation process (DGP). In the article specific issues related to trending variables will be mentioned necessarily. The advantage of levels VAR models over vector error correction models is that they can also be used if the co-integration structure is unknown. ARIMA models are, in theory, the most general form of models for forecasting a time series which can be made to be “stationary” by differencing (if required), perhaps in conjunction with nonlinear transformations such as logging or deflating (if required). An ARIMA model can be viewed as a “filter” that tries to separate the signal from the noise, and the signal is then extrapolated into the future to obtain forecasts.

It is attributed from anecdotal evidence, surveys on banks and financial institution transactions, business expectations, and empirical evidence there is insightful correlation between investment and real interest rate indicated by Rahman (1994). Basically economic cycle, seasonality and time lag on policy actions have greater impact on mapping different rates including tradable and non-tradable. Demand and supply as economic fundamentals is crucial to understand causal effect termed as rates and price.

Section-II

Methodology

Econometric analysis has been performed in this paper. Different economics, statistics and mathematical tools ranging from, unit root, hypothesis testing, Johansen co-integration test, impulse response function (IRF) and variance decomposition are tested in this article to form rational expectation. Forecasting of exchange rate using vector auto regression (VAR) and ARIMA is the fundamental attempt of this paper. In VAR appropriateness of the selected variables will produce robust forecasted exchange rate incorporating the variability comparing other econometric exercise. ARIMA model with autoregressive form and without seasonality treatment addresses the better forecast of Bangladesh exchange rate. These technical analyses of exchange rate will help forming rational expectation by the investors.

Section-III

VAR model variables from macroeconomic perspective

In our VAR finally model 1 four alternative variables have been acknowledged to get economic feedback and dynamic interrelationships. Other two models 2 and 3 did not provide better outcome. Without prior restriction the endogenous variables interaction are checked in the UVAR with regular interval as the monthly data concern. All the macroeconomic variables export, import and remittances are the complementary variables of current account balance of BOP. As a result, the variables are co-integrated based on endogenity and reduced form equation and we cannot reject the null there is unit root. High t values minimum error of the VAR implies the model is significant with long run equilibrium relationship among variables. As central banking is an art we need to properly treat the individual variable to get desired outcome following time path. VAR exercises demonstrate that regressed value of the variables will reasonably contribute in forming rational expectation by the policy makers and other agents of the economy.

Model 1: exrate(X1) lnexport(X2) lnimport(X3) lnremit (X4) (Table 4)

Based on the estimated co-integrating vector (VAR) long-run equilibrium equation we can write following equations by OLS. In the equation u's are the stochastic error terms, called shocks, innovation or impulse in the description of VAR. Seemingly unrelated regression (SURE) technique is used to estimate the equation. Same number of lagged is included in the equation of endogenous variable of OLS estimation. Accordingly, each equation represents identical as well as efficient estimates.

$$exrate = \mathrm{a}o + \sum_{j=1}^{k} \mathrm{a1jX1t} - \mathrm{j} + \sum_{j=1}^{k} \mathrm{a2jX2t} - \mathrm{j} + \sum_{j=1}^{k} \mathrm{a3jX3t} - \mathrm{j} \sum_{j=1}^{k} \mathrm{a4jX4t} - \mathrm{j} + \mathrm{u1t}$$

$$lnexport = \phi o + \sum_{j=1}^{k} \phi \mathrm{1jX1t} - \mathrm{j} + \sum_{j=1}^{k} \phi \mathrm{2jX2t} - \mathrm{j} + \sum_{j=1}^{k} \phi \mathrm{3jX3t} - \mathrm{j} \sum_{j=1}^{k} \phi \mathrm{4jX4t} - \mathrm{j} + \mathrm{u2t}$$

$$lnimport = \alpha o + \sum_{j=1}^{k} \alpha \mathrm{1jX1t} - \mathrm{j} + \sum_{j=1}^{k} \alpha \mathrm{2jX2t} - \mathrm{j} + \sum_{j=1}^{k} \alpha \mathrm{3jX3t} - \mathrm{j} \sum_{j=1}^{k} \alpha \mathrm{4jX4t} - \mathrm{j} + \mathrm{u3t}$$

$$lnremit = \beta o + \sum_{j=1}^{k} \beta \mathrm{1iXjt} - \mathrm{j} + \sum_{j=1}^{k} \beta \mathrm{2jX2t} - \mathrm{j} + \sum_{j=1}^{k} \beta \mathrm{3jX3t} - \mathrm{j} \sum_{j=1}^{k} \beta \mathrm{4jX4t} - \mathrm{j} + \mathrm{u4t}$$

Model 2: lnexrate lnexport lnimport lnremit (not shown in the tabular form)

Model 3: exrate lnexport lnimport lnremit lnindpd- Estimates including lnindpd did not provide better result impacting other variables in the model. (not reported)

Standard error and t-statistics are showing in the first and third brackets incorporating 1 period lag (Table 4). Exchange rate coefficient 1.39 is more elastic by reason of volatility clustering. The elasticity of export is negative 0.83 percent. Import and remittance coefficient are also low in the identical form of VAR (Table 4). Remittance is less volatile and following stable path. Establishing of money changer, anti money laundering and other promotional activities is contributing the remittance growth rather only devaluation. In the VAR model imposing of common lag structure direct to reduction of degrees of freedom. Bearing this in mind VAR is tested with minimum lag. In the exercise we find minimum value of Akaike information criterion and Schwarz criterion. UVAR produces best forecasted outcome for inflation and exchange rate according to Habibur and Sayera, (2007) .Kamal et. Al(2013) paper adopts an econometric analysis of determinants of exchange rate for US Dollar in terms of Bangladeshi currency within the framework of monetary approach. Monthly data from January 1984 to April 2012 for Bangladesh relative to USA have been used to examine the long run and short run behaviour of BDT/USD exchange rate.

The paper finds that real exchange rate and the macroeconomic variables affecting real exchange rate forms a cointrigrating vector. Its observes that stock of money and increase in debt service burden results in a real depreciation of currency, while increasing foreign exchange reserve results in a real appreciation of currency. Moreover, Political instability has a significant negative effect on the value of domestic currency. In our stipulated VAR model incorporation of related variables in the model has contributed to forecast robust exchange rate. Export, import and remittances are the major variables of current account balance (CAB) of BOP. In VAR model incorporating of other variables like foreign direct investment (FDI) and medium and long term (MLT) loan are deterministic, which may not bring robust exchange rate forecast. The appreciation and depreciation of exchange rate in Bangladesh mainly depend on the export, import and remittance. The disequilibrium of exchange rate is corrected with the impact of these variables.

Section-IV

Analyzing the VAR model and exchange rate forecasting

Unit root test: We worked with each variable 60 monthly data sets starting from July 2007 to June 2012. It is crucially important to verify the data is stationary before advancing VAR estimations. In this regard Augmented Dickey-Fuller (ADF 1981), Phillips-Parron (PP 1988) and finally Kwiatkowski-Phillips-Schmidt-Shin (KPSS 1992) have been deployed. Test result demonstrated in (Table 1) and indicates that the variables under consideration are stationary in the first difference. Low p-value of variables supports this inference. All variable are I(1) with different significance level. For KPSS correlogram has also been checked for stationary. Consequently, we accept the null hypothesis (Ho) that the all observed variable has unit root and reject the alternative hypothesis (Ha) there is no unit root. In level most cases t value are less than critical values. So, we cannot reject the null. We accept I(1) process in the level and the data is non stationary. To support this basically we checked the correlogram with p values. If the other roots of the characteristic equation lie inside the unit circle that is, have a modulus (absolute value) less than one then the first difference of the process will be stationary.

Table 1. Result on Unit Root Test on stipulated Variables

	ADF		PP		KPSS	
Variables	With intercept	With trend plus intercept	With intercept	With trend plus intercept	With intercept	With trend plus intercept
exrate	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
lnexport	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
lnimport	I(1)	I(1)	I(1)	I(1)[b]	I(1)	I(1)[c]
lnremit	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
lnindpd	I(1)	I(1)[a]	I(1)	I(1)	I(1)	I(1)

a= 1% level significant; b=5% level significant; c=10% level significant

Notes: 1. All tests have been organized on the basis of 1%, 5% and 10% significance level using Econometric Views 5 package. 2. I(1) means non-stationary. 3. ADF and PP tests have been performed on the null hypothesis of unit root and KPSS test performed verifying correlogram as a diagnostic tool. 4. Lag lenth for ADF for monthly data are decided on the basis of Schwartz's information criteria (SIC). 5. Maximum bandwidth for PP and KPSS tests are based on Newey-West (1994).

Johansen co-integration test: Unrestricted co-integrated rank test pointed that the trace statistics is more than critical value and the p values is 0.0237 (Table 2). Trace test indicates 1 co-integration equation at 0.05 level. Maximum Eigenvalue with respect to hypothesis exhibits that Max-Eigen statistic is higher than critical value. This reject the hypothesis at the 0,05 level. Engle and Granger contributed that a linear combination of two or more non stationary series at different significant level may be stationary. In such case linear combination persists and the non stationary time series are said to be co-integrated. Long run equilibrium relation among the variables are persists (Table 2).

Table 2. Johansen Co-integration Test

Sample (adjusted): 2007M09 2012M06
Trend assumption: Linear deterministic trend
Series: EXRATE LNEXPORT LNIMPORT LNREMIT
Lags interval (in first differences): 1 to 1
Unrestricted Co-integration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.382390	51.15936	47.85613	0.0237
At most 1	0.246354	23.20924	29.79707	0.2359
At most 2	0.090945	6.804981	15.49471	0.6004
At most 3	0.021737	1.274676	3.841466	0.2589

Trace test indicates 1 co-integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.382390	27.95013	27.58434	0.0449
At most 1	0.246354	16.40425	21.13162	0.2021
At most 2	0.090945	5.530306	14.26460	0.6739
At most 3	0.021737	1.274676	3.841466	0.2589

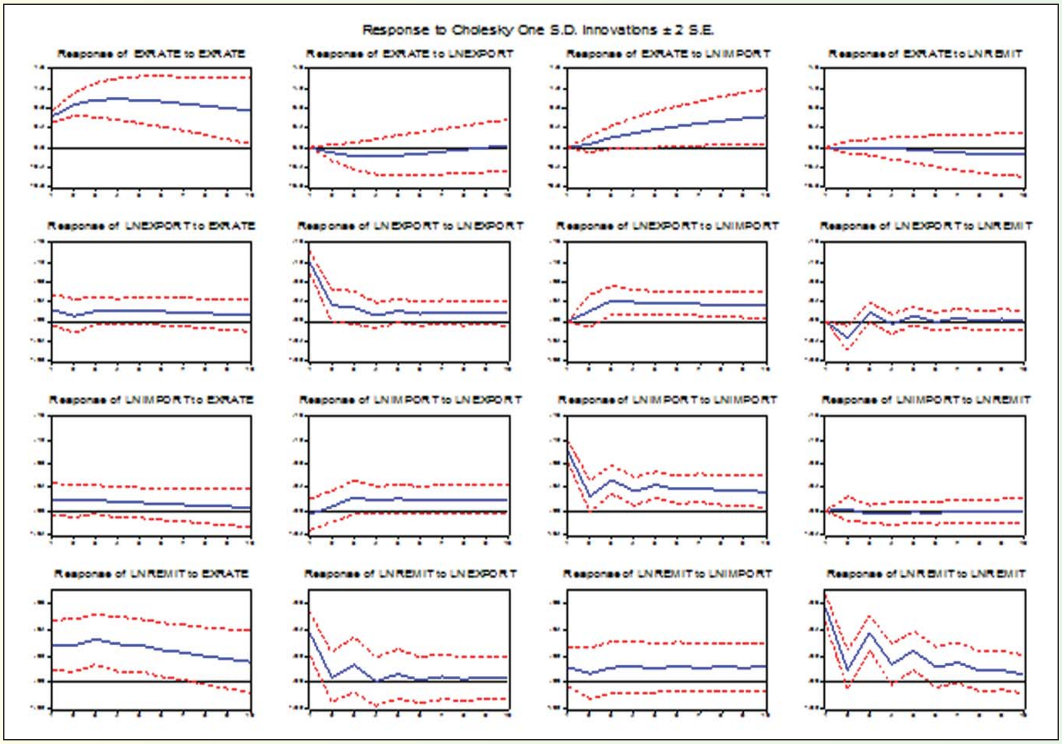
Max-eigenvalue test indicates 1 co-integrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Co-integrating Coefficients (normalized by b'*S11*b=I):				
EXRATE	LNEXPORT	LNIMPORT	LNREMIT	
-0.066626	-7.024374	7.750218	4.142108	
0.118591	-5.869347	3.925713	-3.465000	
0.022004	-3.035012	-4.481322	7.215239	
-0.350611	-0.144706	2.679728	0.474716	
Unrestricted Adjustment Coefficients (alpha):				
D(EXRATE)	0.132210	0.022115	-0.130731	0.055576
D(LNEXPORT)	0.042845	0.046887	0.011158	0.005904
D(LNIMPORT)	-0.031910	-0.013579	0.008130	0.011605
D(LNREMIT)	-0.014955	0.032746	-0.004321	0.004287

Empirical analysis of the test results:

***Exrate, lnexport, lnimport and lnremit impulse response*:** Impulse response of different variables can be observed in (Figure1). Individual variables innovation exhibits mostly positive response at different time horizon. The impulse of exchange rate (exrate) and import (lnimport), export (lnexport) and remittances (lnremit), import and export and remittance and export prolonged up to 9-month, 3-month, 1-month and 4-month respectively. Export and remittances impulse response is very close ending with 1 month. Devaluation of Taka immediately impacts the remittance. The combined impulse response can be found in (Figure 2) with different magnitude. In the group innovations exchange rate and import are prominent. In reality volatility occurs mainly due to increase in overall net short position of the banks. Banks excessive demand for foreign exchange payment initiates the volatility. In this occasion BB sale the foreign exchange for reducing volatility as the banks are allowed to maintain open foreign exchange position considering the capital of balance sheet. Moreover, all accounts of BOP are not fully convertible to bring the foreign credit or other loans by the banks or company. Inoue and Hamori (2004) empirically analyzed the sources of the exchange rate fluctuations in India using monthly data from January 1999 to February 2009 by deploying the structural VAR. The VAR model consists three variables i.e., the nominal exchange rate, the real exchange rate and the relative output of India and a foreign country. The empirical result advocates that real shocks were the main drivers of the fluctuations in real and nominal exchange rates, indicating that the central bank could not maintain the real exchange rate at its desired level over time.

Figure 1. Impulse response plot of exchange rate, export, import and remittance

Figure 2. Combined impulse response plot of exchange rate, export, import and remittance



Variance decomposition on variables: It measures the fluctuation of the observed variables that are responsible for own innovation and other variables in the gamut. Each column of

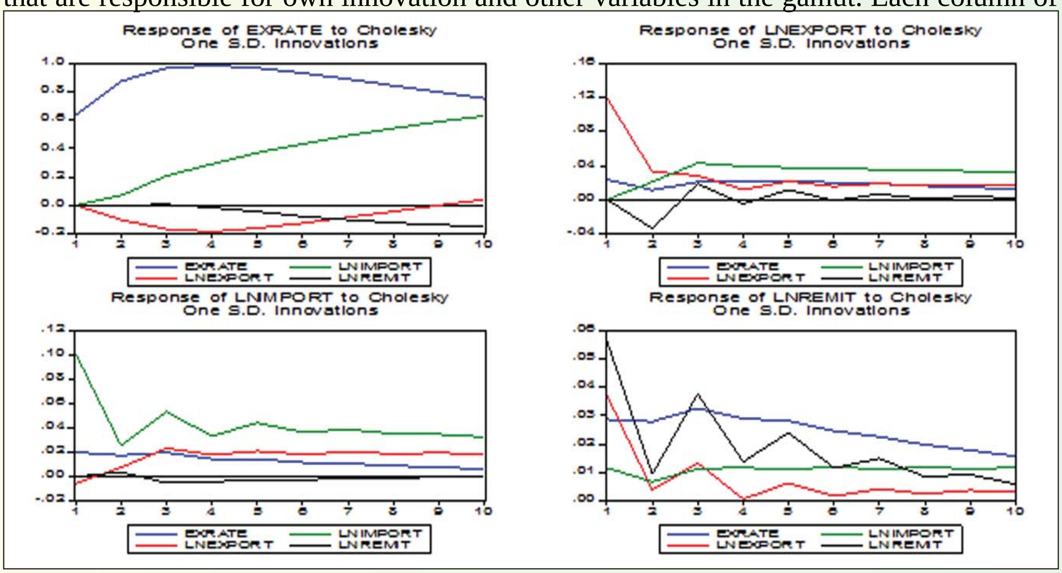


Table 3 summing up to 100 percent owing to percentage of forecast error variance of the innovations. The innovation predicts that own impulse has significant causal relationship as the variables are co-integrated. In the VAR estimate of model 1 own trend has significant impact on other variables. Variance decomposition of lnremit demonstrates that the share of exchange rate, export, import and remittances are 15 percent, 25 percent, 2.5 percent and 57.50 percent. Remittance has greater causality on exchange rate. Due to allowance short position in the foreign exchange market banks are governing from the negative position owing for borrowing considering mathematical and financial conventions. As a result, own innovation of the variable is persistent in the speed of adjustment (Table3**).** Overall ne short position US$ 100 million arise deducting overall long position (US$500 million) from overall short position (US$600 million) of banks. The import is not that much encouraged depending on exchange rate devaluation (Table3). Restriction of luxury items contributes in reduction of import.

Table 3. Variance Decomposition of exchange rate, export, import and remittance

Variance Decomposition of LNREMIT:					
Period	S.E.	EXRATE	LNEXPORT	LNIMPORT	LNREMIT
1	0.074232	14.98364	25.11464	2.450293	57.45143
2	0.080250	24.93988	21.71999	2.804236	50.53589
3	0.096091	28.91536	17.08647	3.345848	50.65231
4	0.101997	33.75897	15.16939	4.301009	46.77063
5	0.109251	36.08092	13.55246	4.750810	45.61581
6	0.113257	38.31229	12.63199	5.560966	43.49475
7	0.117049	39.58967	11.95621	6.099145	42.35498
8	0.119648	40.62891	11.48602	6.836234	41.04884
9	0.121898	41.27726	11.15878	7.439006	40.12496
10	0.123650	41.73331	10.91049	8.132011	39.22419
Cholesky Ordering: EXRATE LNEXPORT LNIMPORT LNREMIT					

Chen (2004) estimated structural VAR model using quarterly data of the USA, Canada, Germany, Japan and the UK ranging 1974:Q to 2002:Q4 by following Clarida and Gali (1994). His results indicate that the variance of real exchange rates can be attributed more to monetary shocks when the sample is extended. He also demonstrated using VAR model with long run annual data from 1989 to 1995 and observe that monetary shock can explain nearly 50 percent of real exchange rate variance in the long run sample period.

Form VAR monthly average forecasted exrate for July, 2012= -4.137+1.389-0.828+0.692+0.016 = -2.868 percent growth over June, 2012 exrate (81.820)=79.474 (under-cast comparing actual 81.772 of July,2012). VAR analysis and forecasting imply that economy of Bangladesh observing interdependence relationship with co-integrating vector.

Table 4. Vector Auto-regression Estimates

Sample (adjusted): 2007M09 2012M06
Included observations: 58 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	EXRATE	LNEXPORT	LNIMPORT	LNREMIT
EXRATE(-1)	1.388523	0.018870	0.014894	0.035631
	(0.13524)	(0.02595)	(0.02193)	(0.01583)
	[10.2673]	[0.72714]	[0.67909]	[2.25014]
EXRATE(-2)	-0.417071	-0.017989	-0.018268	-0.032349
	(0.13770)	(0.02642)	(0.02233)	(0.01612)
	[-3.02893]	[-0.68080]	[-0.81807]	[-2.00642]
LNEXPORT(-1)	-0.828058	0.475138	0.055381	-0.017667
	(0.79446)	(0.15245)	(0.12884)	(0.09302)
	[-1.04229]	[3.11669]	[0.42985]	[-0.18992]
LNEXPORT(-2)	0.158287	-0.086012	0.222114	-0.056987
	(0.78173)	(0.15001)	(0.12677)	(0.09153)
	[0.20248]	[-0.57339]	[1.75206]	[-0.62259]
LNIMPORT(-1)	0.691951	0.277288	0.243652	0.047716
	(0.82632)	(0.15856)	(0.13401)	(0.09675)
	[0.83739]	[1.74875]	[1.81822]	[0.49317]
LNIMPORT(-2)	1.154302	0.204655	0.450393	-0.004220
	(0.83697)	(0.16061)	(0.13573)	(0.09800)
	[1.37914]	[1.27425]	[3.31824]	[-0.04306]
LNREMIT(-1)	0.015826	-0.599238	0.064559	0.167395
	(1.11310)	(0.21359)	(0.18051)	(0.13033)
	[0.01422]	[-2.80549]	[0.35764]	[1.28437]

LNREMIT(-2)	-0.461698	0.697556	-0.085511	0.628051
	(1.09765)	(0.21063)	(0.17801)	(0.12852)
	[-0.42062]	[3.31177]	[-0.48038]	[4.88668]
C	-4.136890	0.042287	0.723505	1.375463
	(3.53478)	(0.67829)	(0.57324)	(0.41389)
	[-1.17034]	[0.06234]	[1.26213]	[3.32329]
R-squared	0.982097	0.806507	0.837311	0.847545
Adj. R-squared	0.979174	0.774917	0.810750	0.822655
Sum sq. resids	19.69457	0.725199	0.517958	0.270011
S.E. equation	0.633979	0.121655	0.102813	0.074232
F-statistic	335.9877	25.52992	31.52358	34.05084
Log likelihood	-50.97553	44.77239	54.53238	73.42390
Akaike AIC	2.068122	-1.233531	-1.570082	-2.221514
Schwarz SC	2.387846	-0.913807	-1.250358	-1.901790
Mean dependent	71.46851	7.325885	7.717088	6.784688
S.D. dependent	4.393063	0.256424	0.236337	0.176272
Determinant resid covariance (dof adj.)		1.84E-07		
Determinant resid covariance		9.37E-08		
Log likelihood		140.1116		
Akaike information criterion		-3.590056		
Schwarz criterion		-2.311160		

Section V

Forecasting of volatility clustering exchange rate using ARIMA

After analyzing mentioned test in classical manner we performed forecasting incorporating seasonal and non-seasonal factors apart from VAR. Following exchange rate own pace observed from VAR the auto regressive integrated moving average (ARIMA) model can be deployed for forecasting. ARIMA (1,0,0) is followed for getting forecasted exchange rate with the help of Minitab software. Non seasonality in ARIMA predicted stable exchange rate (Figure 3) for next six months (July-December, 2012), which is mostly close to actual rate. Six months seasonality demonstrated that there is surge in exchange rate from November to December, 2012 (Figure 4). Non-seasonal and seasonal forecasted value can be found in Table 5 and Table 6 respectively. Sayed (2004) and Banik (2013) have pointed out many forecasting research have shown that the behaviour of exchange rate series cannot be modelled solely by linear time series model (e.g. regression model, AR(p), ARIMA(p,q) and others) because exchange rate nature is most complex(non-linear) and volatile. Therefore, developing a model for forecasting requires an iterative process of knowledge discovery, system improvement through data mining as well as error and trial experimentation. However, Bangladesh's foreign exchange market is limited and experiencing low arbitrage and speculation. For that reason conventional variance decomposition has absolute effect among variables. SWAP transaction based on comparative advantage and currency affluence works for reducing the volatility clustering exchange rate of Bangladesh. Autoregressive form in ARIMA exercise addresses the fixed type of recent exchange rate of Bangladesh. IT based real time settlement of exchange rate has reduced the use of seasonal treatment in ARIMA. Real time solution in exchange rate in Bangladesh has contributed to reduce the asymmetric information and moral hazard in creating volatility. Thus reduced volatility in exchange rate due to technological success has encouraged to use ARIMA (1,0,0) based exchange rate in Bangladesh.

Figure 3. Non seasonal monthly (average) forecasted exchange rate plot using ARIMA

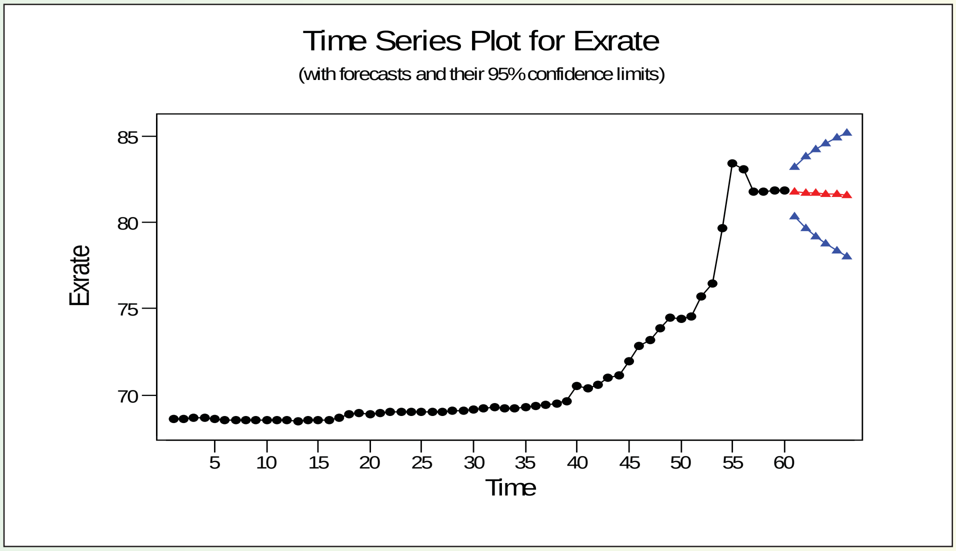


Figure 4. Forecasted monthly (average) exchange rate plot using ARIMA with seasonal treatment

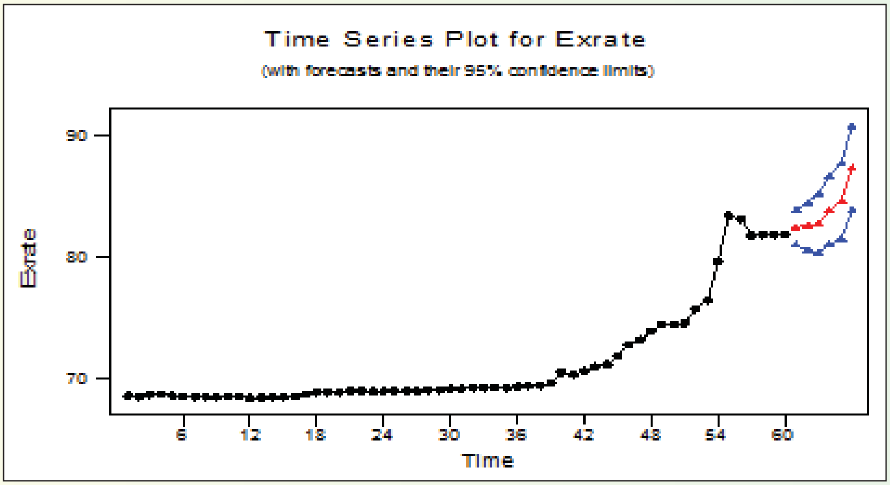


Table- 5. 95% confidence level (with seasonali ty)

(Taka/US$ exchange rate)

Month average	Forecast	Lower	Upper	Actual
July 12	82.432	81.0529	83.8112	81.7715
August 12	82.5303	80.5743	84.4863	81.5160
September 12	82.7584	80.3559	85.1610	81.7286
October 12	83.8163	81.0340	86.5985	81.3123
November 12	84.5619	81.4422	87.6815	
December 12	87.2837	83.8563	90.7111	

Table-6. 95% confidence level (without seasonality) (Taka/US$ exchange rate)

Month average	Forecast	Lower	Upper	Actual
July 12	81.7838	80.3281	83.2395	81.7715
August 12	81.7476	79.6894	83.8058	81.5160
September 12	81.7114	79.1912	84.2317	81.7286
October 12	81.6752	78.7658	84.5847	81.3123
November 12	81.6391	78.3869	84.8913	
December 12	81.6030	78.0412	85.1648	

In time series analysis a linear stochastic process has a unit root if I(d) in certain order of differentiation is stationary. AR(1,2…n) is a auto regressive process showing different order of differentiation identifying unit root of the system of equation. AR(1) represents the data which is stationary in 1st order differentiation. AR(2) refers 2nd order differentiation which is required to make the data stationary. Auto regressive process has been followed to fit the data in linear form for forecasting and forming rational expectation. This order is stationary as it is reached to zero. In this case we can accept the hypothesis or reject the alternative. The hypothesis is Auto correlation function is different from zero after first difference. We reject the hypothesis and find the stationary of the AR process of the data. ARIMA has 3 components. Auto Regressive - AR(1) is stationary in 1st order differentiation. Integrated- I(1) refers to the co integrated process. Moving Average MA(0) is a statistical extrapolation, and treatment is not applied (0). ARIMA (1,0,0) is followed for getting forecasted exchange rate in our study. To deal with reserve money (RM) the ARIMA (1,1,1) may be deployed. RM is basically deterministic variable.

Section VI

Conclusion

In our VAR model exercise the centrepiece is that observed variables are maintaining balanced interdependence relationships. Bangladesh exchange rate is primarily deterministic, which is Keynesians and finally normal trending market behaviour allowing classical from. Volatility of exchange rate is inherent due to economic cycle with arbitrage opportunity and speculation. In spite of this, IT based real time settlement in Bangladesh has reduced the asymmetric information and moral hazard in creating volatility in exchange rate. In our ARIMA model exercise we can forecast the monthly exchange rate in an autoregressive way incorporating steady exchange rate. VAR and ARIMA based technical exchange rate will address the deviation of real exchange rate taking into account information gap of demand and supply for balancing the inflation and GDP growth.

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