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Comparative Autocorrelation Study for Foreign Exchange Reserve and Merchandise Export in India : Development of Prediction Model

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ABSTRACT

The research is having an objective to analyse the monthly data of Foreign Exchange Reserve of India and merchandise export from India since 1990-91. The analysis was aimed at finding an autocorrelation of the said variables. Both the variables are considerably significant in the broader domain of macroeconomic framework. Foreign exchange reserve classifies the strength of government reserve in other currencies to mitigate unforeseen circumstances whereas higher export value signifies better current account and trade position. These parameters have strong correlation with the exchange rate of home currency and on the balance of payment. The degree of autocorrelation exemplifies the dependence of these variables on their past outcome. This study tested the autocorrelation of the variables successfully and through the detailed statistical methodology of unit root testing, ARMA modelling and GARCH modelling, it established a statistical model that emanates the possibility to forecast the variables. This outcome may have significant impact in policy making and predicting future trade trend.

Keywords : Foreign Exchange Reserve in India, Export from India, Autocorrelation, Unit Root Test, ARMA model, GARCH model, EGARCH model

I. INTRODUCTION

The data on foreign exchange reserve position of a country keeps updating us on multiple facets of macroeconomy- the strength of home currency, the macroeconomic risk-taking ability, capability to fund import, trade contingency position and so on. This is even more significant for import-dependent country like India. The data on merchandise export of any country emphasises its global trade position, trade surplus / deficit tendency, current account position, exchange rate position etc. When trade deficit exists in a country, it subsequently impacts current account deficit which is extremely relevant in modern market economy. The composition of foreign exchange reserve (Table 1) depicts that the maximum weightage is for the foreign currency asset held by government. When the current account deficit cannot be compensated by FDI or FPI inflows, the foreign exchange reserves play a key role for macroeconomic balance. The foreign exchange reserve also indicates the availability of contingency funds with the government to provide import support in case ofexpected economic stress. The FDI and FPI can't always compensate the gap of current account deficit resulting in requirement of external borrowing or funding from own reserves. The 93%-95% contribution of foreign currency assets in total foreign exchange reserve explains the ongoing valuation of foreign currency in comparison with home currency and its changes reflect the situational improvement / degradation of home currency. This has some correlation with the export amount from the country due to its capability to strengthen home currency. Table 1 also depicts an approximate 200% increase in foreign currency reserve of India in April 2019 in comparison with April 2005. Furthermore, the two variables, namely export value and foreign exchange reserve, have been considered for review and analysis to invigorate the meta-data analysis for finding out inner traits of the datasets for forecasting.

Table 1

Year	Month	Foreign Currency Assets		Gold		Reserve Tranche Position		SDRs		Total
		(USD Million)	% of Reserve	(USD Million)	% of Reserve	(USD Million)	% of Reserve	(USD Million)	% of Reserve	(USD Million)
2019	Apr	390966	93.4%	23022	5.5%	3351	0.8%	1454	0.3%	418793
2018	Apr	395277	94.0%	21662	5.2%	2056	0.5%	1523	0.4%	420517
2017	Apr	349056	93.5%	20439	5.5%	2347	0.6%	1460	0.4%	373302
2016	Apr	339025	93.4%	20043	5.5%	2471	0.7%	1511	0.4%	363049
2015	Apr	327153	93.0%	19336	5.5%	1317	0.4%	4063	1.2%	351869
2014	Apr	283707	91.2%	20966	6.7%	1838	0.6%	4475	1.4%	310986
2013	Apr	263322	89.6%	23974	8.2%	2240	0.8%	4356	1.5%	293892
2012	Apr	260839	88.5%	26618	9.0%	2915	1.0%	4474	1.5%	294846
2011	Apr	282037	90.0%	23790	7.6%	3013	1.0%	4671	1.5%	313511
2010	Apr	254773	91.1%	18537	6.6%	1341	0.5%	4982	1.8%	279633
2009	Apr	241487	95.9%	9231	3.7%	983	0.4%	1	0.0%	251702
2008	Apr	304225	96.8%	9427	3.0%	485	0.2%	18	0.0%	314155
2007	Apr	196899	96.3%	7036	3.4%	463	0.2%	11	0.0%	204409
2006	Apr	153598	95.6%	6301	3.9%	772	0.5%	6	0.0%	160677
2005	Apr	135950	95.8%	4443	3.1%	1443	1.0%	5	0.0%	141841

Previous Research

Various research work has been undertaken and accomplished earlier on the foreign exchange reserve and export value of multiple countries, but the autocorrelation study and modeling of the variables are hardly available in research domain. Bhattacharya B, Mookherjee J, in 2001 and Doong, S.-Ch., Yang, Sh.-Y., Wang, A., in 2005, in their research papers elaborated the aspects of the importance of foreign exchange reserve and its impact on trade deficit, exchange rate and even in stock market for emerging countries. Mohammad, S. D., Hussain, A., & Ali, A., in 2009 and Aizenman, J. and Marion, N., in 2002, assessed the impact of foreign exchange reserve on domestic economy in case of middle-east countries.

Disyatat, P., in 2001 and Greenspan, A, in 1991 stated the importance of foreign exchange reserve in macroeconomic stability. They also highlighted the examples of some emerging countries who were capable of maintaining strong reserve position and converted themselves to trade power house. They suggested to incorporate the provision of purchasing foreign currency by government to make the reserve position stronger and also advised that well-informed calculatedpurchase of the foreign currency is an excellent mode of investment and hedging.

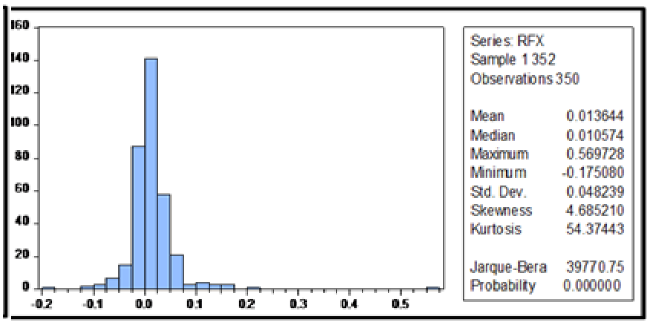
Kenen, P. and Yudin, E., in 1965, and Ford, J.L. and Huang, G., in 1994 worked out the evolution of the concept of higher forex reserve by global superpowers. This got reclarified and more specific with the advent of globalization and liberalization. All these studies covered the aspects of forex reserve and its gradual change for many countries. These papers also justified the changing trend in the field of merchandise export and investment in foreign currency. This paper mostly covers the quantitative aspects of the meta-data to analyze the possibility of finding an autocorrelation of the variables.

Initial Theoretical framework and Methodology

This research work, as stated earlier, aimed at establishing relationship of foreign exchange reserve (FX) of India and export from India (EX) with their past values. In other words autocorrelation of the said parameters was tested in this paper. As the theoretical framework goes, the data points were collected from relevant sources and the analysis has been performed based on monthly data from FY 1990-1991 to the last available data (June / July 2019). The log returns for both the variables have been calculated for all analytical purposes due to higher chance of normalization. The log returns of Foreign Exchange Reserve (RFX) and Export from India (REX) data were initially placed in histograms to have an overview of normalization effect. Subsequently, the data series statistical exercises were performed that started with correlogram to analyze the existence of autocorrelation. This was revalidated by Breusch-Godfrey Serial Correlation LM test. The Unit Root Testing was performed next with Augmented Dicky Fuller test to verify the stationarity of the variables barring which the unit roots take the future prediction and data model equation away from the expected trajectory. Once the stationarity was established, both RFX and REX was modeled in terms of Autoregressive Moving Average (ARMA) models and the variables were both tested on ARMA(1,1) and ARMA(2,2) models. Once the acceptability of the models was decided on the probability factors and t-statistics at 5% significance level, it is concluded that the modeling of the variable with that specific autocorrelated model is possible. These models were further tested for their respective variances with General Autoregressive Conditional Heteroskedasticity (GARCH) and Exponential GARCH (EGARCH) models.

Presentation of data and explanation

The initial representation of the data vide histograms (Figure 1) confirms that the normalization trend in the data set is present. The export data set is less skewed than foreign exchange data which is reconfirmed with higher value of Kurtosis and very high value of Jarque-Bera. Once the initial representation of the variables is performed, the autocorrelation tendency is tested with correlogram with 18 lags and the same was revalidated by Breusch-Godfrey Serial Correlation LM test. In both the tests, the hypothesis Null Hypothesis H0: There is no autocorrelation in the Indian forex reserve and export data and Alternate Hypothesis H1: There is autocorrelation in the Indian forex reserve and export data. The correlogram (Figure 2) for export data clearly indicates autocorrelation from first lag and the same is present from third lag in case of foreign exchange. This was established due to very low p-value and significant Q-statistics. Very low Chi-square value and significant F-statistic in Breusch-Godfrey Serial Correlation LM test (Figure 3) confirm the presence of autocorrelation in both the variables. This helps the analysis to be conducted further to derive the model for representing the variables for future prediction. The presence of Unit root in the data sets was checked with Augmented Dicky Fuller test. Unit roots disrupt stationarity of any variable and hinder the process of modelling the



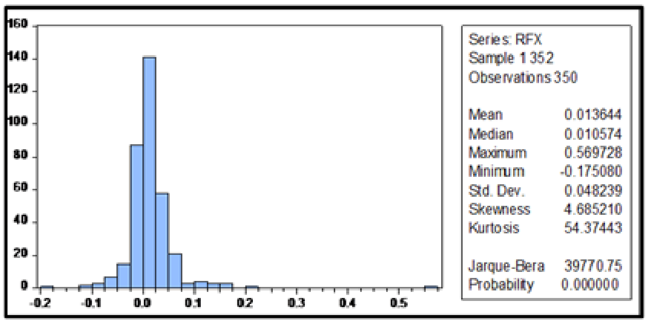


Figure 1

Sample: 1 352
Included observations: 351

Lag	AC	PAC	Q-Stat	Prob
1	-0.348	-0.348	42.750	0.000
2	-0.016	-0.156	42.842	0.000
3	0.014	-0.054	42.912	0.000
4	-0.132	-0.173	49.124	0.000
5	0.021	-0.113	49.282	0.000
6	0.004	-0.069	49.289	0.000
7	0.021	-0.020	49.447	0.000
8	-0.150	-0.213	57.594	0.000
9	0.032	-0.156	57.971	0.000
10	-0.007	-0.131	57.987	0.000
11	-0.290	-0.503	88.619	0.000
12	0.680	0.435	257.74	0.000
13	-0.236	0.087	278.09	0.000
14	-0.011	-0.005	278.14	0.000
15	0.030	0.006	278.48	0.000
16	-0.150	-0.118	286.85	0.000
17	0.048	-0.042	287.72	0.000
18	0.057	0.072	288.94	0.000

Sample: 1 352
Included observations: 350

Lag	AC	PAC	Q-Stat	Prob
1	-0.018	-0.018	0.1198	0.729
2	0.070	0.070	1.8519	0.396
3	0.233	0.237	21.135	0.000
4	-0.026	-0.020	21.374	0.000
5	0.041	0.006	21.973	0.001
6	-0.100	-0.160	25.530	0.000
7	-0.062	-0.067	26.894	0.000
8	-0.013	-0.012	26.956	0.001
9	0.073	0.160	28.885	0.001
10	-0.123	-0.094	34.332	0.000
11	0.049	0.044	35.200	0.000
12	0.080	0.026	37.529	0.000
13	-0.038	0.003	38.051	0.000
14	0.108	0.066	42.341	0.000
15	-0.030	-0.020	42.673	0.000
16	-0.021	-0.054	42.841	0.000
17	0.138	0.109	49.928	0.000
18	0.012	0.054	49.978	0.000

Figure 2

variable for forecasting. The tests were performed for both the variables with only constant and constant with linear trend. The results (Figure 4) highlight that t-statistic (calculated t-value) or $t_{stat}<t_{critical}$ obtained from the ADF table. This rejects the null hypothesis and confirms the alternate hypothesis of no unit root for both the variables. As the stationarity of the variables are established due to absence of unit roots, the variables were experimented to be modelled with ARMA model. Both the

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 6 lags

F-statistic	7.052116	Prob. F(6,343)	0.0000
Obs*R-squared	38.43487	Prob. Chi-Square(6)	0.0000

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 6 lags

F-statistic	13.12740	Prob. F(6,344)	0.0000
Obs*R-squared	65.39411	Prob. Chi-Square(6)	0.0000

Figure 3

variables were tested with ARMA(1,1) (Figure 5) and ARMA(2,2) (Figure 6) models and the results, with the help of probability and t-statistics, depicted that export data can be modelled with ARMA(1,1) whereas foreign exchange reserves data can be represented as ARMA(2,2) model. The derived co-efficient in both the cases resulted in the representation of the variables with its past values due to the

Null Hypothesis: REX has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.607668	0.0000
Test critical values:	1% level	-3.449447	
	5% level	-2.869850	
	10% level	-2.571266	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: RFX has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.817940	0.0000
Test critical values:	1% level	-3.449389	
	5% level	-2.869825	
	10% level	-2.571253	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: REX has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 11 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.607006	0.0000
Test critical values:	1% level	-3.985361	
	5% level	-3.423136	
	10% level	-3.134497	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: RFX has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 9 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.446699	0.0000
Test critical values:	1% level	-3.985280	
	5% level	-3.423097	
	10% level	-3.134474	

*MacKinnon (1996) one-sided p-values.

Figure 4

presence of autocorrelation. The export data and the foreign exchange reserve data can be representedas: $\mathbf{REX_t= 0.008328+ \varepsilon_t+0.390452REX_{t-1}-0.860746\varepsilon_{t-1}}$ in case of export data set at any time period t and $\mathbf{RFX_t= 0.013451+ \varepsilon_t+1.271108RNE_{t-1}-0.787041RNE_{t-2}-1.312159\varepsilon_{t-1}+0.949649\ \varepsilon_{t-2}}$ in case of

Dependent Variable: REX
Method: ARMA Maximum Likelihood (OPG - BHHH)
Sample: 2 352
Included observations: 351
Convergence achieved after 39 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008328	0.002056	4.049877	0.0001
AR(1)	0.390452	0.065874	5.927248	0.0000
MA(1)	-0.860746	0.048759	-17.65291	0.0000
SIGMASQ	0.019222	0.001176	16.35041	0.0000

R-squared	0.206594	Mean dependent var	0.007634
Adjusted R-squared	0.199735	S.D. dependent var	0.155871
S.E. of regression	0.139439	Akaike info criterion	-1.089070
Sum squared resid	6.746757	Schwarz criterion	-1.045073
Log likelihood	195.1318	Hannan-Quinn criter.	-1.071560
F-statistic	30.11832	Durbin-Watson stat	2.057968
Prob(F-statistic)	0.000000		
Inverted AR Roots	.39		
Inverted MA Roots	.86		

Dependent Variable: RFX
Method: ARMA Maximum Likelihood (OPG - BHHH)
Sample: 2 351
Included observations: 350
Convergence achieved after 34 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.013644	0.003293	4.142704	0.0000
AR(1)	-0.160254	1.756745	-0.091222	0.9274
MA(1)	0.137368	1.763103	0.077912	0.9379
SIGMASQ	0.002319	7.97E-05	29.11297	0.0000

R-squared	0.000540	Mean dependent var	0.013644
Adjusted R-squared	-0.008125	S.D. dependent var	0.048239
S.E. of regression	0.048435	Akaike info criterion	-3.205835
Sum squared resid	0.811689	Schwarz criterion	-3.161745
Log likelihood	565.0212	Hannan-Quinn criter.	-3.188286
F-statistic	0.062360	Durbin-Watson stat	1.989288
Prob(F-statistic)	0.979613		
Inverted AR Roots	-.16		
Inverted MA Roots	-.14		

Figure 5

foreign exchange reserve data set. These equations may also be used as forecasting tool for the said variables. Due to the acceptability of ARMA-fit models in case of both the variables, the variances can

Dependent Variable: REX
Method: ARMA Maximum Likelihood (OPG - BHHH)
Sample: 2 352
Included observations: 351
Convergence achieved after 44 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008359	0.002304	3.627813	0.0003
AR(1)	0.288949	0.763234	0.378585	0.7052
AR(2)	0.132244	0.296508	0.446004	0.6559
MA(1)	-0.791899	0.768715	-1.030159	0.3037
MA(2)	-0.075933	0.658386	-0.115333	0.9082
SIGMASQ	0.019064	0.001154	16.52463	0.0000

R-squared	0.213077	Mean dependent var	0.007634
Adjusted R-squared	0.201672	S.D. dependent var	0.155871
S.E. of regression	0.139270	Akaike info criterion	-1.085989
Sum squared resid	6.691629	Schwarz criterion	-1.019993
Log likelihood	196.5911	Hannan-Quinn criter.	-1.059723
F-statistic	18.68330	Durbin-Watson stat	1.990152
Prob(F-statistic)	0.000000		
Inverted AR Roots	.54	-.25	
Inverted MA Roots	.88	-.09	

Dependent Variable: RFX
Method: ARMA Maximum Likelihood (OPG - BHHH)
Sample: 2 351
Included observations: 350
Convergence achieved after 165 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.013451	0.004015	3.349907	0.0009
AR(1)	1.271108	0.050129	25.35667	0.0000
AR(2)	-0.787041	0.044259	-17.78247	0.0000
MA(1)	-1.312159	0.040670	-32.26320	0.0000
MA(2)	0.949649	0.036369	26.11116	0.0000
SIGMASQ	0.002129	7.33E-05	29.03352	0.0000

R-squared	0.082438	Mean dependent var	0.013644
Adjusted R-squared	0.069102	S.D. dependent var	0.048239
S.E. of regression	0.046543	Akaike info criterion	-3.275955
Sum squared resid	0.745177	Schwarz criterion	-3.209819
Log likelihood	579.2922	Hannan-Quinn criter.	-3.249631
F-statistic	6.181339	Durbin-Watson stat	2.065862
Prob(F-statistic)	0.000017		
Inverted AR Roots	.64-.62i	.64+.62i	
Inverted MA Roots	.66+.72i	.66-.72i	

Figure 6

Dependent Variable: REX
Method: ML ARCH - Normal distribution (OPG - BHHH / Marquardt steps)
Sample (adjusted): 3 352
Included observations: 350 after adjustments
Failure to improve likelihood (non-zero gradients) after 78 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: 2
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.007693	0.004833	1.591949	0.1114
AR(1)	0.318836	0.203921	1.563527	0.1179
MA(1)	-0.843408	0.111375	-7.572678	0.0000
Variance Equation				
C	0.014533	0.015052	0.965526	0.3343
RESID(-1)^2	0.148781	0.147271	1.010249	0.3124
GARCH(-1)	0.598781	0.374397	1.599320	0.1097

R-squared	0.202924	Mean dependent var	0.008052
Adjusted R-squared	0.198330	S.D. dependent var	0.155897
S.E. of regression	0.139584	Akaike info criterion	-0.864041
Sum squared resid	6.760873	Schwarz criterion	-0.797905
Log likelihood	157.2071	Hannan-Quinn criter.	-0.837716
Durbin-Watson stat	1.931137		
Inverted AR Roots	.32		
Inverted MA Roots	.84		

Dependent Variable: REX
Method: ML ARCH - Normal distribution (OPG - BHHH / Marquardt steps)
Sample (adjusted): 3 352
Included observations: 350 after adjustments
Convergence achieved after 45 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: 2
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)
*RESID(-1)/@SQRT(GARCH(-1)) + C(7)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.001888	0.003242	-0.582416	0.5603
AR(1)	0.636126	0.069953	9.093615	0.0000
MA(1)	-0.868304	0.046232	-18.78126	0.0000
Variance Equation				
C(4)	-4.360645	0.362555	-12.02755	0.0000
C(5)	0.811706	0.109094	7.440449	0.0000
C(6)	-0.502787	0.089869	-5.594638	0.0000
C(7)	0.144561	0.081333	1.777393	0.0755

R-squared	0.122144	Mean dependent var	0.008052
Adjusted R-squared	0.117085	S.D. dependent var	0.155897
S.E. of regression	0.146487	Akaike info criterion	-1.553749
Sum squared resid	7.446053	Schwarz criterion	-1.476590
Log likelihood	278.9060	Hannan-Quinn criter.	-1.523037
Durbin-Watson stat	2.393216		
Inverted AR Roots	.64		
Inverted MA Roots	.87		

Figure 7

also be modelled. We have tested the variance modelling for both the variables with GARCH and EGARCH models. For export dataset, the EGARCH model complies to the significance of the model at 5% level (Figure 7) for all coefficients except c (7) but the GARCH model fails to do so for all coefficients. With the feasibility of the EGARCH model the variance for export data points can be expressed as:

$$\log(\sigma_t^2) = -4.360645 + 0.144561\log(\sigma^2_{t-1}) - 0.502787\, \varepsilon_{t-1}/(\sqrt{\sigma^2_{t-1}}) + 0.811706\left[(I\varepsilon_{t-1}I/\sigma^2_{t-1}) - \sqrt{\frac{2}{\pi}} \right]$$

Dependent Variable: RFX
Method: ML ARCH - Normal distribution (OPG - BHHH / Marquardt steps)
Sample (adjusted): 4 351
Included observations: 348 after adjustments
Convergence not achieved after 500 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: 2 3
Presample variance: backcast (parameter = 0.7)
GARCH = C(6) + C(7)*RESID(-1)^2 + C(8)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.015155	0.001788	8.477323	0.0000
AR(1)	0.425863	0.140294	3.035495	0.0024
AR(2)	0.331681	0.097530	3.400804	0.0007
MA(1)	-0.017126	0.139843	-0.122467	0.9025
MA(2)	-0.289141	0.054302	-5.324677	0.0000
Variance Equation				
C	4.71E-05	3.98E-06	11.83516	0.0000
RESID(-1)^2	0.148530	0.014425	10.29639	0.0000
GARCH(-1)	0.598530	0.027506	21.76018	0.0000

R-squared	-0.147171	Mean dependent var	0.013648
Adjusted R-squared	-0.160549	S.D. dependent var	0.048376
S.E. of regression	0.052115	Akaike info criterion	-3.566153
Sum squared resid	0.931574	Schwarz criterion	-3.477596
Log likelihood	628.5106	Hannan-Quinn criter.	-3.530897
Durbin-Watson stat	2.743922		
Inverted AR Roots	.83	-.40	
Inverted MA Roots	.55	-.53	

Dependent Variable: RFX
Method: ML ARCH - Normal distribution (OPG - BHHH / Marquardt steps)
Sample (adjusted): 4 351
Included observations: 348 after adjustments
Failure to improve likelihood (non-zero gradients) after 53 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: 2 3
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(6) + C(7)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(8)
*RESID(-1)/@SQRT(GARCH(-1)) + C(9)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.005425	0.001525	3.556421	0.0004
AR(1)	-0.302650	0.101546	-2.980424	0.0029
AR(2)	0.608841	0.083834	7.262468	0.0000
MA(1)	0.562158	0.118666	4.737316	0.0000
MA(2)	-0.357864	0.096336	-3.714748	0.0002
Variance Equation				
C(6)	0.086728	0.013848	6.262933	0.0000
C(7)	0.006803	0.020068	0.339016	0.7346
C(8)	-0.071301	0.012364	-5.766722	0.0000
C(9)	1.009751	6.33E-07	1594097.	0.0000

R-squared	-0.073207	Mean dependent var	0.013648
Adjusted R-squared	-0.085722	S.D. dependent var	0.048376
S.E. of regression	0.050407	Akaike info criterion	-4.288179
Sum squared resid	0.871511	Schwarz criterion	-4.188553
Log likelihood	755.1431	Hannan-Quinn criter.	-4.248516
Durbin-Watson stat	2.522480		
Inverted AR Roots	.64	-.95	
Inverted MA Roots	.38	-.94	

Figure 8

This equation is useful to evaluate future variances as well. While assessing similar data points for foreign exchange reserve in India, the variances can be well-expressed by GARCH and EGARCH models. However, GARCH model fits it with all coefficients but EGARCH has restriction with c (7). Hence the variances have been considered to be modelled with GARCH model and can be represented as: $\sigma_t^2 = 4.71e^{-5} + 0.148530\, \varepsilon^2_{t-1} + 0.598530\, \sigma^2_{t-1}$

4.2. Source of Data

The above analysis was based on data available at Reserve Bank of India official data portal (dbie.rbi.org.in). The selected data set contains forex reserve data and export data since 1990-1991 and has more than 350 data points each. The subsequent analysis has been performed with EViews software.

4.3. Scope and limitations of research

The research work covers two key aspects of macroeconomic indicators and trade balance health of any country. In case of India, the study has been performed to assess the dependency of present data on its past. The same analysis could have been performed for few other countries to ascertain a comparative positioning. Few other parameters related with the present research work namely import, current account deficit etc. have not been included to maintain the objective orientation. More data points could have been useful to derive the coefficients more precisely, but could not be done due to unavailability of the data beyond 1990-91.

II. CONCLUSION

This research work is a combination of identification of macroeconomic indicators, analysis of its relevance with its past data through statistical tools and modelling its forecasting equation with econometrics application. The study established that foreign exchange reserve and merchandise export values for India are autocorrelated parameters. Hence, for both the parameters, past value means a lot to predict future values resulting in an authentic and statistically modelled guideline for forecasting. This autocorrelation for forex reserve emanated that the present reserve position would impact the future reserve position by reducing the probability of volatility impact to a great extent. Similarly, the export data analysis and the autocorrelation established from that proves the importance of improving the present position to have a reasonably balanced future. The models and equations established are extremely helpful for future projection that may be used as a guiding tool. This assessment may also help the policy makers to change their focus on policy intervention and initiatives resulting in lesser dependence on market volatility and more focussed approach in predictive model-dependent policy measures to have an improved trade balance.

III. REFERENCES

[1]. Bhattacharya B, Mookherjee J (2001), Causal relationship between and exchange rate, foreign exchange reserves, value of trade balance and stock market: case study of India. Department of Economics, Jadavpur University, Kolkata, India.

[2]. Doong, S.-Ch., Yang, Sh.-Y., Wang, A., 2005. “The dynamic relationship and pricing of stocks and exchange rates: Empirical evidence from Asian emerging markets,” Journal of American Academy of Business, Cambridge, Vol.7, No1, pp.118-23.

[3]. Mohammad, S. D., Hussain, A., & Ali, A. (2009), Impact of Macroeconomics Variables on Stock Prices – Emperical Evidance in Case of KSE. European Journal of Scientific Research, vol.38 no. 1, pp96-103.

[4]. Aizenman, J. and Marion, N. "The High Demand for International Reserves in the Far East: What's Going On?" Working Paper, UC Santa Cruz and the NBER; Dartmouth College, 2002

[5]. Beaufort and Kapteyn. "Reserve Adequacy in Emerging Market Economies" Working Paper, International Monetary Fund, 2001

[6]. Disyatat, P. "Currency Crisis and Foreign Reserves: A Simple Model" Working Paper, International Monetary Fund, 2001

[7]. Greenspan, A. 'Currency Reserves and Debt'. Remakrs at the World Bank Conference on Trends in Reserves. April, 1999.

[8]. Kenen, P. and Yudin, E. "The Demand for International Reserves" The Review of Economics and Statistics, 47, 1965: 242-250

[9]. Ford, J.L. and Huang, G. "The Demand for International Reserves in China: An ECM Model with Domestic Monetary Disequilibrium" Economica, 67, 1994: 379-97

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