

USD/INR Future Price Predictive Modelling Considering Macro Economic Factors

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Abstract- Indian economy is sensitive towards the relation between Indian Rupee (INR) and US Dollar (USD) exchange rate (USD/INR rate). As US dollar strengthens against Rupee, Current account deficit (CAD) deteriorates and affects India's Gross domestic product (GDP) adversely. That is why it becomes important to predict the future USD/INR exchange rate to get an idea about the future representation of India's GDP. There are several macroeconomic factors which are considered to be affecting currency exchange rate such as GDP of country, Political stability and economic performance, Inflation rate, Terms of trade, CAD, Foreign exchange reserve (FOREX), Consumer price index for industrial worker (CPI-IW) and Brent crude oil price etc. This study is dedicated towards predicting future relation between USD/INR exchange rates. For our study, among above mentioned macroeconomic factors, we have considered GDP, Call money rate, Consumer price index for industrial worker, Brent crude oil price, FOREX and CAD. Data of each considered factors are gathered from Bloomberg terminal – A data compilation platform. For our study we have used quarter wise data of each parameter for the duration from January 2002 to September 2018. We have analysed data from quarter one 2002 to quarter four 2014 of each macroeconomic factors to build 63 different exchange rate predictive models considering one/two/three/four/five/six macroeconomic factors affecting currency exchange rate. USD/INR rate is predicted for quarter one 2014 to quarter two 2018. Among these models, best goodness of fit is chosen using Chi-square value and Akaike information criterion. Based on our study it is found that only three factors – CAD, FOREX and Call rate – influence USD/INR exchange rate the most. The study was done to make an attempt to formulate and establish a relationship between exchange rate and its variables and use predictive modeling to forecast the most accurate value of exchange rate in future.

Index Terms- Regression, USD/INR Exchange rate, Predictive Modelling, Hypothesis testing

I. INTRODUCTION

Karen Fernandes (2017) used multiple regression technique to verify the impact of inflation, forex reserves and interest rates on Exchange rate of the Indian rupee and Granger causality to study if there exists a causal link between the variables. The study was conducted using annual data of 6 variables viz. Gross Domestic Product (GDP), interest

rates, foreign exchange reserves, imports, exports and inflation for a period of 26 years i.e. from 1990-2016. Results indicated a uni-directional causal relationship between GDP and exports, GDP and Inflation rate and between Imports and inflation rate. The results of the Johansen Co-Integration test indicated that all the chosen variables were highly co-integrated in the long run.

Chandan Sharma and Rajat Setia (2015) used the fully modified ordinary least square, Wald's coefficient restriction and impulse response functions (IRF) to estimate the monetary model in the long- and short-run horizons. The IRF illustrated the importance of interest rate in controlling exchange rate volatility.

Gautam Kamble and Parmeshwar Honrao (2014) used Generalized Autoregressive Conditional Heteroskedastic (GARCH 1,1) model to establish the degree of exchange rate volatility between 2011 and 2013 in India.

Saritha (2016) concluded that domestic interest differentials and interest yield differentials, and the rate of change of foreign exchange reserves have a significant impact on the monthly average of the USD/INR exchange rate. A monthly time series from June 2007 to May 2012 was used for the purpose. It suggested that short-term and long-term relationship of NYSE ACRA, FOREX reserve, imports and exports of India exists with exchange rates of India.

Krishna Murari used the Generalized Autoregressive Conditional Heteroskedastic (GARCH) models to estimate volatility in the daily log rupee value. It estimated volatility of Indian rupee instability against four major world currencies, i.e., US dollar, pound sterling, euro and Japanese yen, using observations over a period of 13 years (2000 – 2013).

The exchange rate has direct impact on nation's international trade, economic growth as well as on their interest rate. It is important to understand what causes exchange rate fluctuations. Investors and policy makers constantly try to forecast the change of the exchange rate in an attempt to minimize the risk of holding currency.

Exchange rates float freely against one another. Valuations of currency are determined by the inflow and outflow of it in a country. A high demand for a particular currency means that value of that currency will increase. The highlighting reasons contributing towards the depreciation of Indian rupee are mentioned hereby.

Higher rate of Inflation indicated by Consumer Price Index makes Indian goods more expensive thereby causing a decline in exports of goods from India. Supply of dollars will decline resulting in weak rupee. Current account deficit widens when

imports are more than exports. Foreign currency goes out of the country.

Trade deficit increases the demand for dollars causing it to appreciate. India buys more crude oil than it sells i.e. it is a net buyer of the commodity. Price hikes in crude oil cause imports to be expensive. Rise in oil prices result in an increased import bill which further leads to the widening of current account deficit.

Call money market rate is the rate at which banks borrow money without collateral from other banks for one day (overnight basis). Lower interest rates as compared to US will lead to capital outflows resulting in increase in demand for dollars. A country's central bank holds currencies of foreign countries in the form of foreign exchange reserves. The most important reason why banks hold reserves is to manage their currency values. Reserve Bank of India intervenes in the currency market to maintain orderly market conditions. It can sell US Dollars in the open market to reduce the money supply. RBI is in-charge of the country's FOREX reserves and it fluctuates depending on various factors like Import-Export balance, USD/INR prices, etc. FOREX reserves also acts as a stabilizing agent for the exchange rate in times of market volatility as RBI quickly reacts to appreciation/depreciation of the currency by buying and selling of US bonds in dollar terms. As there several factors which one or other way affect the USD/INR rate, it becomes important to study which macroeconomic parameters manipulate the exchange rate the most.

II. LITERATURE REVIEW

Primary objective of this study is to analyse the various macroeconomic factors which are taken in consideration. Using this analysis we have to build different models with permutation and combination of macroeconomic factors. On this different model we have to perform hypothesis testing and find best goodness of fit. We have to find correlation between/among various macroeconomic factors involved in chosen model if any. We have to use these correlation factors to predict the future value of USD/INR rate.

III. METHODOLOGY

As seen in the introduction, we find that there were a number of factors affecting USD/INR rate. For the purpose of this research we've taken GDP, Call Money Rate, CPI-IW, Crude Oil, FOREX (Source: <https://www.rbi.org.in/scripts/ReferenceRateArchive.aspx>) and CAD as the parameters that significantly affect the exchange rate. So, USD/INR exchange rate will act as a dependent variable (y) and the 6 parameters considered will act as independent variables.

For the regression model to be efficient and reliable, data input should be as high as possible. In our research, data for call rate before 2004 wasn't available so data for all the parameters was taken from 01-01-2004 to 30-06-2018 i.e. Q2 of 2018 since GDP data wasn't available for Q3 2018. Since the exchange rate is in rupee terms, the Crude oil prices and FOREX reserves amount have been taken in rupee terms. Also, CAD is taken as a percentage share of GDP.

The data for Call rate and Crude oil prices were available in day-to-day basis. CPI-IW numbers were in monthly basis followed by GDP, FOREX and CAD data available on quarterly basis. For ease of calculations, data available for daily and monthly basis was converted to quarterly basis by taking an average for the said period.

All the data was then converted to percentage change compared to previous period in order to maintain data consistency. After the process of data cleaning is done, the final data can now be used as an input on which the linear and multiple regression models can be applied.

We will be using data from Q2 2004 to Q4 2014 in order to predict data for Q1 2015 to Q2 2018 and compare it with actual data to see the best for our research. The formula to be used for multiple linear regression model is:

$$Y = \beta_0 + \beta_1 * X_{i-1} + \beta_2 * X_{i-2} + \beta_3 * X_{i-3} + \dots \beta_n * X_{i-n}$$

Where,

Y = Currency quarterly return

β_0 = Intercept

β_i = coefficient value, $i = 1, 2, 3 \dots n$

X_i = Dependent variable (Various macro-economic factors), $i = 1, 2, 3 \dots n$

Open-source free programming software 'R' (Version- 3.5.1) is used for the calculation of intercept and coefficient values of each of model. As we have 6 parameters, the permutation and combination of all these parameters have given a total of 63 models. To find the best goodness of fit among these models, we further calculate Akaike's Information Criterion (AIC) which is an estimator of the relative quality of statistical models for a given set of data that is followed by a Chi-Square test on all the models.

We first select the model that is closest to 0 based on AIC and then narrow down our choices with the highest corresponding p-value of chi-square test. The model consisting of Call rate, FOREX and CAD was selected based on our research method. Going forward, to predict values from Q3 2018 to Q2 2020 we have assume a 1% increment and decrement on one parameter and calculated the correlation of this parameter with other two. The process is repeated with other two parameters and three final models were built.

IV. RESULT

$$Y_i = \beta_0 + \beta_1 * X_{i-1} + \beta_2 * X_{i-2} + \beta_3 * X_{i-3} + \dots \beta_n * X_{i-n}$$

Every parameter including currency quarterly average values were taken in terms of percentage return. Currency value was considered as Independent variable (Y) whereas other macro-economic factors were considered as dependent parameters (Xi). This is because value of currency was dependent on variation of macroeconomic factors. We have used single and multiple regression method to predict the future currency quarterly return for the duration quarter one 2014 to quarter two 2018. Following was the regression equation used for calculation:

$Y = \beta_0 + \beta_1 * X_{i-1} + \beta_2 * X_{i-2} + \beta_3 * X_{i-3} + \dots + \beta_n * X_{i-n}$
 Where,
 Y = Currency quarterly return
 β_0 = Intercept

β_i = coefficient value, $i = 1, 2, 3 \dots n$

X_i = Dependent variable (Various macro-economic factors), $i = 1, 2, 3 \dots n$

As we had six different macroeconomic parameters, using different permutation and combination we had built 63 different models. (Using combination as ${}^6C_1, {}^6C_2, {}^6C_3, {}^6C_4, {}^6C_5, {}^6C_6$)
 Now, let us consider model number 7 to predict the quarterly two 2002 currency price percentage returns: Brunt crude oil price and Call rate as

Independent variable (X_i).

So, equation becomes: $Y = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2$ Where,
 Y = Quarterly currency return

β_0 = Intercept

β_1 = coefficient value of Brunt crude oil price

β_2 = Coefficient value of Call rate

X_1 = Brunt crude oil price quarterly return X_2 = Call rate quarterly return

We had used R programming - open source statistical software - to solve the equation and following results were obtained:

$\beta_0 = -0.01036$

$\beta_1 = 0.063426$

$\beta_2 = -0.005755$

Based on historical data: $X_1 = 11.6512726\%$
 $X_2 = -1.0024961\%$

$Y = -0.01036 + (0.063426 * 11.6512726\%) + (-0.005755 * -1.0024961\%)$

$Y = -0.2914370190169\%$

This value was multiply by actual average quarterly currency value (Q1 2002, Rs. 45.23) Q2 2002 predicted value = Predicted percentage return * Actual Q1 avg. currency value
 $= -0.2914370190169\% * 45.23$

$= 45.37$

Now this predicted Q2 2002 value was used to predict the Q3 2002 value, Q3 2002 value was used to predict the Q4 2002 value and so on. Similarly values till Q2 2018 were predicted. Same method was used and all the predicted values were tabulated in table 2. Below table 1 shows model number and parameters considered in it.

V. DATA ANALYSIS

Table 1: Model Number and macroeconomic factors taken as dependent variable

Model Number	No. of Parameters	para1	para2	para3	para4	para5	para6
1	1	CRUDE					
2	1	CALLRATE					
3	1	CPI					
4	1	CAD					
5	1	GDP					
6	1	FOREX					
7	2	CRUDE	CALLRATE				
8	2	CRUDE	GDP				
9	2	CRUDE	CPI				
10	2	CRUDE	CAD				
11	2	CALLRATE	GDP				
12	2	CALLRATE	CPI				
13	2	CALLRATE	CAD				
14	2	GDP	CPI				
15	2	GDP	CAD				
16	2	CPI	CAD				
17	2	CRUDE	FOREX				
18	2	CALLRATE	FOREX				
19	2	GDP	FOREX				
20	2	CPI	FOREX				
21	2	CAD	FOREX				

22	3	CRUDE	CALLRATE	GDP			
23	3	CRUDE	CALLRATE	CPI			
24	3	CRUDE	CALLRATE	CAD			
25	3	CRUDE	GDP	CPI			
26	3	CRUDE	GDP	CAD			
27	3	CRUDE	CPI	CAD			
28	3	CALLRATE	GDP	CPI			
29	3	CALLRATE	GDP	CAD			
30	3	CALLRATE	CPI	CAD			
31	3	GDP	CPI	CAD			
32	3	CRUDE	CALL RATE	FOREX			
33	3	CRUDE	GDP	FOREX			
34	3	CRUDE	CPI	FOREX			
35	3	CALLRATE	GDP	FOREX			
36	3	CALLRATE	CPI	FOREX			
37	3	GDP	CPI	FOREX			
38	3	CRUDE	CAD	FOREX			
39	3	CALLRATE	CAD	FOREX			
40	3	GDP	CAD	FOREX			
41	3	CPI	CAD	FOREX			
42	4	CRUDE	CALLRATE	GDP	CPI		
43	4	GDP	CPI	CAD	CRUDE		
44	4	CPI	CAD	CRUDE	CALLRATE		
45	4	CAD	CALLRATE	GDP	CPI		
46	4	CAD	CRUDE	CALLRATE	GDP		
47	4	CRUDE	CALLRATE	GDP	FOREX		
48	4	CALLRATE	GDP	CPI	FOREX		
49	4	GDP	CPI	CAD	FOREX		
50	4	CRUDE	CALLRATE	CPI	FOREX		
51	4	CRUDE	CALLRATE	CAD	FOREX		
52	4	CALLRATE	GDP	CAD	FOREX		
53	4	CRUDE	GDP	CPI	FOREX		
54	4	CRUDE	GDP	CAD	FOREX		
55	4	CRUDE	CPI	CAD	FOREX		
56	4	CALLRATE	CPI	CAD	FOREX		
57	5	CRUDE	CALLRATE	GDP	CPI	CAD	
58	5	CRUDE	CALLRATE	GDP	CPI	FOREX	
59	5	CALLRATE	GDP	CPI	CAD	FOREX	
60	5	GDP	CPI	CAD	FOREX	CRUDE	
61	5	CPI	CAD	FOREX	CRUDE	CALLRATE	
62	5	CAD	FOREX	CRUDE	CALLRATE	GDP	
63	6	CRUDE	CALLRATE	GDP	CPI	CAD	FOREX

Table 2.1 – 2.8: Predicted values of USD/INR rates

Table 2.1: Predicted values of USD/INR rates

Quarter	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
45	64.54	64.58	64.78	64.54	65.09	64.45	65.75	65.55
46	65.05	65.10	65.55	65.05	66.43	64.83	65.69	66.59
47	65.54	65.63	66.36	65.54	67.75	65.41	67.07	68.22
48	66.07	66.16	67.13	66.07	69.22	66.15	68.26	69.92
49	66.59	66.70	67.94	66.59	70.49	66.77	69.79	71.56
50	67.03	67.24	68.74	67.03	71.93	67.35	69.07	72.41
51	67.46	67.78	69.57	67.46	73.49	68.05	69.78	73.97
52	68.03	68.33	70.49	68.03	75.20	68.92	70.08	75.48
53	68.67	68.88	71.42	68.67	77.06	69.87	70.52	77.19
54	69.58	69.44	72.40	69.58	79.04	70.40	71.72	79.36
55	70.19	70.00	73.36	70.19	80.98	70.89	72.36	81.23
56	70.81	70.57	74.30	70.81	82.88	71.71	72.23	82.70
57	71.48	71.14	75.22	71.48	84.74	72.12	72.57	84.34
58	72.07	71.72	76.18	72.07	86.58	72.92	72.59	85.81

Table 2.2: Predicted values of USD/INR rates

Quarter	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
45	65.96	65.69	65.05	64.79	64.55	64.92	65.05	64.78
46	66.20	65.67	66.33	65.56	65.06	66.06	66.35	65.56
47	67.89	67.02	67.62	66.36	65.57	67.16	67.63	66.37
48	69.37	68.21	69.04	67.13	66.10	68.44	69.07	67.16
49	71.19	69.70	70.32	67.94	66.63	69.48	70.31	67.99
50	70.80	68.96	71.69	68.74	67.08	70.71	71.66	68.71
51	71.84	69.56	73.25	69.57	67.50	72.01	73.09	69.46
52	72.55	69.92	74.93	70.48	68.09	73.41	74.79	70.44
53	73.43	70.48	76.76	71.42	68.74	74.92	76.67	71.52
54	75.10	72.02	78.77	72.39	69.66	76.53	78.89	72.92
55	76.20	72.72	80.71	73.35	70.27	78.10	80.83	73.97
56	76.47	72.69	82.61	74.29	70.90	79.65	82.74	75.02
57	77.19	73.15	84.48	75.21	71.57	81.17	84.64	76.10
58	77.60	73.20	86.35	76.17	72.16	82.64	86.46	77.12

Table 2.3: Predicted values of USD/INR rates

Quarter	Model 17	Model 18	Model 19	Model 20	Model 21	Model 22	Model 23	Model 24
45	65.54	64.43	65.03	64.74	64.44	65.55	56.06	65.69
46	65.49	64.79	66.29	65.46	64.83	66.51	57.04	65.64
47	66.83	65.36	67.61	66.46	65.38	68.12	58.77	66.98
48	68.10	66.08	69.13	67.57	66.07	69.78	60.24	68.16
49	69.58	66.70	70.40	68.59	66.66	71.45	62.04	69.66
50	69.07	67.25	71.83	69.56	67.15	72.20	62.86	68.88
51	69.87	67.95	73.42	70.70	67.73	73.75	64.44	69.47
52	70.44	68.81	75.22	72.16	68.56	75.22	66.16	69.81
53	71.18	69.75	77.20	73.73	69.50	76.90	68.05	70.35
54	72.30	70.26	79.13	74.87	70.31	79.10	70.46	71.88
55	72.90	70.74	81.00	75.95	70.84	80.97	72.57	72.57
56	73.04	71.56	82.97	77.37	71.66	82.42	74.22	72.52
57	73.31	71.96	84.72	78.30	72.18	84.06	76.00	72.96
58	73.55	72.75	86.62	79.71	72.94	85.52	77.80	73.00

Table 2.4: Predicted values of USD/INR rates

Quarter	Model 25	Model 26	Model 27	Model 28	Model 29	Model 30	Model 31	Model 32
45	65.39	65.52	65.94	64.85	65.02	64.79	64.92	65.53
46	66.29	66.52	66.20	65.91	66.27	65.57	66.06	65.43
47	67.73	68.11	67.88	66.93	67.53	66.39	67.15	66.74
48	69.26	69.77	69.36	68.13	68.93	67.20	68.43	67.99
49	70.70	71.39	71.20	69.16	70.18	68.03	69.48	69.48
50	71.41	72.13	70.74	70.28	71.47	68.77	70.64	68.90
51	72.76	73.56	71.69	71.55	72.92	69.52	71.88	69.69
52	74.04	75.06	72.48	72.86	74.58	70.51	73.30	70.23
53	75.48	76.80	73.50	74.31	76.44	71.60	74.90	70.94
54	77.33	79.20	75.58	75.89	78.66	73.01	76.79	72.05
55	78.92	81.07	76.77	77.40	80.60	74.08	78.42	72.62
56	80.13	82.54	77.16	78.90	82.51	75.13	80.03	72.73
57	81.52	84.23	78.03	80.39	84.42	76.22	81.65	72.98
58	82.71	85.66	78.50	81.83	86.26	77.24	83.15	73.19

Table 2.5: Predicted values of USD/INR rates

Quarter	Model 33	Model 34	Model 35	Model 36	Model 37	Model 38	Model 39	Model 40
45	65.47	65.81	64.98	64.73	64.91	65.57	64.43	65.02
46	66.48	66.08	66.17	65.42	66.03	65.52	64.82	66.28
47	68.09	67.79	67.44	66.40	67.18	66.83	65.36	67.56
48	69.79	69.42	68.92	67.50	68.54	68.07	66.04	69.03
49	71.42	71.28	70.21	68.52	69.64	69.54	66.64	70.28
50	72.30	71.13	71.56	69.46	70.90	68.90	67.12	71.62
51	73.88	72.35	73.15	70.60	72.29	69.57	67.70	73.08
52	75.48	73.46	74.93	72.04	73.84	70.08	68.52	74.83
53	77.28	74.77	76.90	73.60	75.53	70.80	69.46	76.78
54	79.39	76.49	78.85	74.73	77.17	72.25	70.26	78.95
55	81.22	77.65	80.71	75.80	78.77	72.91	70.80	80.85
56	82.77	78.32	82.69	77.21	80.45	73.02	71.61	82.79
57	84.36	79.05	84.44	78.12	81.96	73.41	72.13	84.64
58	85.89	79.82	86.37	79.53	83.56	73.58	72.89	86.49

Table 2.6: Predicted values of USD/INR rates

Quarter	Model 41	Model 42	Model 43	Model 44	Model 45	Model 46	Model 47	Model 48
45	64.74	65.35	65.40	65.94	64.85	65.47	65.44	64.84
46	65.47	66.15	66.29	66.17	65.92	66.48	66.36	65.86
47	66.44	67.53	67.73	67.84	66.95	68.09	67.94	66.94
48	67.50	68.99	69.26	69.31	68.15	69.79	69.62	68.23
49	68.50	70.43	70.73	71.16	69.19	71.42	71.27	69.32
50	69.38	71.00	71.36	70.66	70.26	72.30	72.05	70.48
51	70.40	72.32	72.63	71.60	71.47	73.88	73.62	71.84
52	71.81	73.50	73.94	72.36	72.82	75.48	75.18	73.32
53	73.37	74.87	75.47	73.36	74.35	77.28	76.97	74.96
54	74.82	76.70	77.62	75.43	76.18	79.39	79.12	76.58
55	75.96	78.23	79.26	76.60	77.75	81.22	80.93	78.12
56	77.38	79.38	80.53	76.97	79.31	82.77	82.47	79.77
57	78.42	80.72	82.01	77.82	80.88	84.36	84.04	81.24
58	79.80	81.86	83.23	78.28	82.36	85.89	85.58	82.82

Table 2.7: Predicted values of USD/INR rates

Quarter	Model 49	Model 50	Model 51	Model 52	Model 53	Model 54	Model 55	Model 56
45	64.91	65.80	65.56	64.97	65.36	65.52	65.83	64.73
46	66.03	66.01	65.47	66.17	66.26	66.51	66.11	65.46
47	67.15	67.71	66.78	67.42	67.71	68.09	67.81	66.42
48	68.47	69.31	68.00	68.86	69.28	69.76	69.39	67.48
49	69.55	71.19	69.48	70.12	70.75	71.38	71.26	68.48
50	70.74	70.96	68.79	71.40	71.51	72.13	70.97	69.35
51	72.01	72.17	69.46	72.89	72.91	73.57	72.06	70.36
52	73.52	73.24	69.94	74.62	74.30	75.10	73.10	71.77
53	75.20	74.53	70.65	76.57	75.87	76.87	74.40	73.33
54	77.10	76.24	72.08	78.73	77.73	79.25	76.47	74.77
55	78.73	77.37	72.72	80.61	79.33	81.10	77.70	75.90
56	80.41	78.00	72.81	82.57	80.66	82.61	78.34	77.32
57	82.02	78.70	73.18	84.40	82.04	84.27	79.20	78.36
58	83.58	79.45	73.35	86.28	83.33	85.72	79.91	79.73

Table 2.8: Predicted values of USD/INR rates

Quarter	Model 57	Model 58	Model 59	Model 60	Model 61	Model 62	Model 63
45	65.36	65.31	64.84	65.37	65.82	65.46	65.34
46	66.15	66.10	65.88	66.26	66.06	66.38	66.13
47	67.54	67.50	66.94	67.70	67.75	67.94	67.53
48	69.01	69.00	68.21	69.24	69.32	69.58	69.02
49	70.48	70.47	69.28	70.71	71.19	71.23	70.49
50	70.99	71.10	70.38	71.35	70.86	71.90	71.02
51	72.24	72.48	71.65	72.63	71.94	73.36	72.31
52	73.46	73.78	73.10	73.96	72.97	74.86	73.57
53	74.91	75.29	74.74	75.52	74.25	76.62	75.08
54	77.01	77.15	76.58	77.66	76.30	78.99	77.17
55	78.59	78.69	78.16	79.30	77.50	80.83	78.76
56	79.80	79.96	79.81	80.60	78.12	82.33	80.01
57	81.22	81.29	81.36	82.07	78.96	83.97	81.43
58	82.39	82.56	82.92	83.31	79.66	85.44	82.64

AIC and Chi- square value of each model were calculated and tabulated in table number3

Table 3: The Akaike information criterion and Chi square value for each model

Model Number	Chi Square value	AIC value	Model Number	Chi Square value	AIC value
1	0.999	-152.448	33	0.038	-153.413
2	0.999	-150.461	34	0.369	-148.93
3	0.919	250.8734	35	0.050	-153.532
4	0.999	283.333	36	0.614	-147.44
5	0.040	-156.996	37	0.179	-153.154
6	0.996	-151.222	38	0.966	-149.265
7	0.981	264.3548	39	0.997	-147.638
8	0.038	262.3792	40	0.047	-153.442
9	0.609	252.852	41	0.597	-147.845
10	0.973	263.8711	42	0.265	-151.87
11	0.050	264.444	43	0.156	-151.791
12	0.919	-148.556	44	0.557	-151.818
13	0.999	-149.174	45	0.309	-147.297
14	0.256	230.9034	46	0.390	263.8679
15	0.048	248.0393	47	0.049	-151.874
16	0.871	247.0005	48	0.254	-151.592
17	0.964	-150.752	49	0.188	-151.482
18	0.997	-149.237	50	0.416	-146.997
19	0.040	-155.11	51	0.973	-147.295
20	0.589	-149.425	52	0.056	-151.775
21	0.997	-149.637	53	0.143	-151.444
22	0.048	-153.801	54	0.044	-151.444
23	0.741	-148.5997	55	0.376	-147.448
24	0.978	-149.161	56	0.606	-145.846
25	0.183	-153.408	57	0.227	-150.187
26	0.046	-153.787	58	0.209	-149.919
27	0.528	-149.281	59	0.254	-149.829
28	0.354	228.9106	60	0.152	-149.819
29	0.056	-153.714	61	0.407	-145.478
30	0.861	-147.297	62	0.055	-150.155
31	0.223	-153.461	63	0.208	-148.194
32	0.974	-148.819			

Model which had AIC value closer to zero and higher Chi square p-value was chosen. Based on observation model 39 which had AIC value - 147.683 and Chi square p-value 0.997 was chosen. Model 39 consists of Call rate, CAD and FOREX as microeconomic factors. So, result shows that these three factors contribute maximum in fluctuating USD/INR rate. Before predicting USD/INR rate from Q3 2018 to Q2, correlation between these three parameters were calculated and tabulated below in table 4.

Table 4: Correlation between Call rate, FOREX and CAD

	Call Rate	CAD	FOREX
Call Rate	1	0.093738	0.044855
CAD	0.093738	1	0.071009
FOREX	0.044855	0.071009	1

Next we assumed one factor to increase and decrease by 1% and found out expected percentage increase and decrease in other two factors using R programming.

Table 5: Correlation value of macroeconomic factors

Increase by 1%	Call Rate	CAD	FOREX	Decrease by 1%	Call Rate	CAD	FOREX
Call Rate	1%	0.0937%	0.0449%	Call Rate	-1%	-0.0937%	-0.0449%
CAD	0.0937%	1%	0.0710%	CAD	-0.0937%	-1%	-0.0710%
FOREX	0.0449%	0.0710%	1%	FOREX	-0.0449%	-0.0710%	-1%

As we already had intercept and correlation values pertaining to model 39, same values were used with corresponding microeconomic factors' predicted values of percentage increase/decrease. Let us consider there was 1% increase in Call rate. Using these values USD/INR exchange rates was calculated.

Y = Quarterly currency return

β_0 = Intercept

β_1 = coefficient value of Call rate

β_2 = Coefficient value of CAD

β_3 = Coefficient value of FOREX Predicted values of

X1 = Call rate quarterly return

X2 = CAD quarterly return

X3 = FOREX quarterly return

Following regression equation was used: $Y = \beta_0 + \beta_1 * X1 + \beta_2 * X2 + \beta_3 * X3$

$$\beta_0 = -0.0109851$$

$$\beta_1 = -0.001089$$

$$\beta_2 = -0.0044969$$

$$\beta_3 = 0.0008345$$

Based on predicted values:

$$X1 = 1\%$$

$$X2 = 0.09373834\%$$

$$X3 = 0.0448547\%$$

$$Y = -0.0109851 + (-0.0109851 * 1\%) + (-0.001089 * 0.09373834\%) + (0.0008345 * 0.0448547\%)$$

$$Y = -1.46380210485082\%$$

Now this value was multiply by Q2 2018 predicted value to get Q3 2018, similarly Q3 2018 value was used to predict the Q4 2018 value and so on. Similarly process was followed assuming CAD and FOREX to increase or decrease by 1% respectively. Using these values USD/INR rate were predicted and tabulated in table 5.

Table 6.1 – 6.3: Predicted values of USD/INR exchange rate

Table 6.1: Predicated values when Call rate is assumed to be increased/decreased by 1%

Quarter	Predicated Values (1% increase)	Predicated Values (1% Decrease)
58	72.89	72.89
59	73.95	74.76
60	75.04	76.69
61	76.13	78.66
62	77.25	80.69
63	78.38	82.77
64	79.53	84.90
65	80.69	87.08
66	81.87	89.32

Table 6.2: Predicated values when CAD was assumed to be increased/decreased by 1%

Quarter	Predicated Values (1% increase)	Predicated Values (1% Decrease)
58	72.89	72.89
59	74.32	74.39
60	75.79	75.93
61	77.28	77.50
62	78.81	79.10
63	80.36	80.74
64	81.95	82.41
65	83.56	84.11
66	85.21	85.85

Table 6.3: Predicated values when FOREX rate was assumed to be increased/decreased by 1%

Quarter	Predicated Values (1% increase)	Predicated Values (1% Decrease)
58	72.89	72.89
59	74.34	74.38
60	75.82	75.90
61	77.33	77.45
62	78.88	79.03
63	80.45	80.65
64	82.05	82.30
65	83.69	83.98
66	85.36	85.70

VI. CONCLUSION

Linear regression method helps to build model which predicts the values for dependent variable considering single or

multiple independent variables. The present study reveals that linear regression method has effectively been used to predict the future values of currency from Q3 2018 to Q2 2020. The developed model is built considering various macroeconomic

factors. Similar models can be modelled considering more macroeconomic parameters. The macroeconomic factors which were used as independent variable were carefully analysed ensuring data consistency. AIC value with p value of Chi-square is used in tandem to select the best goodness of fit among these models. Despite the fact that this study succeeded to model and predicts the expression values for the given data, the robustness of suggested model is not appropriately assessed to generalize the model. This work leads to many other applications such as the predicting value of one of the independent variables provided other factors are known. The inclusion of other macroeconomic factors into the model may improve the robustness of the proposed model.

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