

EXPLORING THE IMPACT OF MACRO ECONOMIC VARIABLES ON EXCHANGE RATE: A Case of some Developed and Developing Countries

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Abstract

Exchange rate is one of the most examined and analyzed financial variable which is operated by the government. Exchange rate plays a key role in the development of economic health and level of trade. The higher the exchange rate is the lower the trade of balance. Whereas, the lower exchange rate would increase the trade of balance of country. In this study, we tried to explore the relationship between the gross domestic product growth (GDP growth), consumer price index (Inflation) and interest rate with the exchange rate for the developed and developing countries. Three G7 countries Canada, UK, and Japan and three developing countries India, Brazil, and South Africa are selected for this purpose. Using the OLS regression estimation and Granger causality test, the results show that GDP growth, inflation and interest rate have a strong influence on the exchange rate for both the developed and developing countries. Moreover, we also used the panel data analysis. The results show strong and significant impact of all macroeconomic variables on the exchange rate. Since, the exchange rate is very important and critical in a free market economy, therefore, it is suggested to the policy makers that they should be attentive to control the system so that the fluctuation in any macroeconomic variable will not be able to disbalance the market performance.

Key words: Exchange rate, Gross Domestic Product, Consumer Price Index (Inflation), Interest Rate, Developed and Developing.

I. Introduction

The exchange rate is simply the value of the local currency of a country for the purpose of conversion to any another currency of other country. The exchange rate facilitates international trade for imports and exports. It is also use for the funds transfer among the countries. At the same time, exchange rate allows the prices comparison of goods and services for different countries i.e. the purchasing power parity PPP [Abdoh, et al. (2016)]. For International trade and finance stability, the exchange rates always play an important role. The exchange rate is a very useful macroeconomic variable utilized as parameter for deciding the strength and position of economy of a country worldwide.

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The world is distributed into two major groupings of countries, known as developed and developing countries. The key economic and financial factors by which the classification perform for these countries are based on the gross domestic product (GDP growth), consumer price index (inflation), exchange rate, gross national product (GNP), industrial and manufacturing productions, living standards etc. Any country related to the exchange rate by means of development. A stable exchange rate can help undertaking and money related establishments in evaluating the execution of speculations, financing and supporting and accordingly decreasing their operational dangers [Samea, et al. (2014)]. Many macroeconomic variables such as GDP growth, interest rate, inflation, Industrial production, political stability, unemployment rate and treasury bills etc. have an impact on the exchange rate [Ramasamy and Abar (2015)].

The macroeconomic indicators which usually used to forecast an exchange rate are similar to those which are usually used to evaluate the complete economic health of a country. The gross domestic product (GDP growth), consumer price index (inflation), producer price index (PPI), employment data and interest rates are all key determining factors for the exchange rates for any country.

It is also noticed that the fluctuations in the exchange rate affects the development of private multinational organizations. Furthermore, it is also build a level of risk for money related foundations like banks, and trade related to the stock markets as well as firms. A brief literature suggests that the fluctuations in the exchange rate are mostly affected by the performance of the macroeconomic variables. Medura (2006) revealed that the fluctuations in the exchange rate are actually due to the variation in the demand and supply of many macroeconomic factors like GDP growth, interest rate, inflation, Industrial production, political stability, unemployment rate and treasury bills etc. Generally, the developing countries have higher imports as compare to the exports. Therefore, the exchange rate increases the purchasing cost by means of payments of products and other services from the well developed countries [Abbas, et al. (2012)]. After the financial insecurity in some of the distinctive countries, the fluctuation in the economy is same regarding the characteristics in currency. It has been observed that some countries ineffectively performed, throughout the previous couple of years. In these countries, the exchange rate is assumed to be an extremely important factor for the national financial circumstances.

A very significant macroeconomic factor is the interest rate. Interest rate is assumed a noteworthy part in exchange rate determination [Ramasamy and Abar (2015)], Bosworth (2014) disagrees with the role of interest rate in the economic growth. They described there is a very little relation between the economy growths with interest rate. However, Medura (2006) reveals that the interest rate is a very important factor which has an impact on the fluctuations of exchange rate. In this paper, we focused on the impact of macroeconomic factors such as consumer price

index rate (inflation), gross domestic product (GDP growth) and interest rate on the exchange rate of developed and developing countries. To explore the impact on the exchange rate fluctuations, these macroeconomic variables are selected due to the inconclusive literature regarding the relationship with the exchange rate. Also, these three independent macroeconomic variables i.e. GDP growth, inflation and interest rate plays the key role in the determination of the economic health of any country and these variables are also used for many international forecast organizations for the forecast purpose of exchange rate. The aim of this study is to share in existing literature by finding the impact of macroeconomic variables on exchange rate movements using three developed G7 countries and three emerging developing countries.

This paper is organized as follows: Section II present the literature review. Section III explains the theoretical frame work and model specification, Section IV contain empirical frame work and data source while Section V discusses the results obtained by analysis. Finally, Section VI concludes the paper.

II. Review of Literature

From the literature review, it seems that many other macroeconomic variables such as Exports, imports, Stock price index, metal prices, manufacturing and industrial production, and Money monitory supply had studied with the exchange rate but GDP growth, inflation and interest rate are the most of the favorite macroeconomic variables for the researchers and economists to find out the relationship with the exchange rate.

Edison and Paula (1991) studied the relationship of interest rate and exchange rate for the quarterly data. Unlike some other studies which favors the relationship of macroeconomic factors with exchange rate, they concluded that there is no impact of interest rate on exchange rate on long run. Similarly, McPherson, et al. (2000) proved that there is no relationship between the GDP growth with exchange rate. Their empirical analysis showed that the there is no impact of interest rate on the exchange rate. But in the same year, Macdonal and Nagayasu (2000) studied the relationship of interest rate and exchange rate for the quarterly time series data which from 1976 to 1997 of fourteen industrialized countries. They found that a long run relationship between the exchange rate and interest rate. Also, Madura (2006) studied the market interaction. He found that the exchange rate depends on the market interaction. He also concluded that the GDP growth often have negative effect whenever the exchange rate system is fixed. Kurihara (2006) disagreed with Madura (2006). He investigated the relationship between macroeconomic variables and stock prices. He agrees with Edison and Paula (1991) that the interest rate has not much effect on the stock prices. However, there is an impact of exchange rate on the stock prices.

Abbas, et al. (2012) investigated the relationship between gross domestic product, inflation and real interest rate with the exchange rate using data from 1996 to 2010 of ten African countries. They concluded that GDP growth has significant relationship with the exchange rate but interest rate and inflation has no relationship with the exchange rates regarding to the African countries. Thereafter, Samea, et al. (2014) explored the relationship of exchange rate with the seven macroeconomic variables. They used the quarterly time series data from 1998 (first quarter) to 2012 (4th quarter). According to their results, inflation rate, balance of payment and industrial production has a relationship with the exchange rate. Recently, Ramasamy and Abar (2015) used bootstrapping technique to analyze the impact of macro-economic factors on the exchange rate. They found that all macroeconomic factors i.e., Interest rate, GDP growth and inflation except employment and budget deficit have an impact on exchange rate on the basis of yearly data. Abdoh, et al. (2016) also studied the impact of export, inflation rates and interest rates on the exchange rate. They used the yearly from 2005 to 2014 of ASEAN countries. According to their findings, there is no significant impact of inflation and interest rate on the exchange rate but export has a significant impact on the exchange rate.

III. Theoretical Framework and Model Specification

Accordingly, this study is aimed at to explore the impact of selected macroeconomic variables namely GDP growth, inflation and interest rate and on exchange rate of three developed countries from G7 and three developing countries by using the OLS regression and Panel data estimation. Moreover, pair-wise correlation is used to determine the relationship of all these macroeconomic variables. Furthermore, the granger causality test is also used to evaluate the causal relationship between the exchange rate and other three macroeconomic variables. Ramasamy and Abar (2015), and Madura (2000) points tht there is a relationship in exchange rate and other macro-economic variables i.e., GDP growth, interest rate, government intervention, balance of payments, political stability, inflation and public debt. Abbas, et al. (2015) concluded that there is only relation present between the GDP growth and exchange rate for African countries. This study is an extension of Abbas, et al. (2015) to explore the relation of exchange rate with the inflation, GDP growth and interest rate.

This study will also be useful for the developing countries by taking steps in order to boost their value of currency by keeping the eyes on these macroeconomic variables. The support was taken from literature in this regard. The selection of developed countries, namely Japan, Canada and UK are selected because they world largest economies i.e., from G7 countries. Also, their domestic currency is independent as compare to other developed G7 countries like France, Germany and Italy as they have the same domestic currency namely Euro. While the three developing

countries namely Brazil, South Africa and India are selected because they are the most extra ordinary emerging countries in the field of economy from last few years.

Variables Explanation

1. Dependent Variable: Exchange rate

Exchange rate is the dependent variable in this study. Exchange rate is simply the value that a currency has compared to another currency [Krugman (2001)]. The exchange rate volatility can affect the decision of policy makers of a country.

2. Independent Variables

a) Inflation

Inflation is the expansion in the prices of products and facilities in an economy which is measured by the inflation. Kibria, et al. (2014) stated that the distribution of income of any country affects by the inflation which can be calculated from the inflation. The inflation has a strong impact on the economy.

b) Gross Domestic product (GDP growth)

GDP growth is actually gives an image of whole situation regarding the economy of a country. It can be illustrated by an example of a satellite rotating in a space that can give the whole image regarding the weather for a particular area. A GDP growth always gives confidence to the policy makers as well as national banks of a country to make the right decisions whether the economy is contracting or extending [Samuelson and Nordhaus (2000)].

c) Interest rate

Interest rate is assumed a noteworthy part in exchange rate determination. One of the most important macroeconomic factor is the interest rate which is the profit after some time because of monetary instruments. Also, an interest rate is often expressed as an annual percentage of the principal.

IV. Empirical Framework and Data Sources

In this study, the data has been taken from Canada, Japan UK, South Africa, Brazil and India on the basis of quarterly time series. For Japan, Canada and UK, the data covers the first quarter of 1970 to the last quarter of 2015. For Brazil, the

data is taken from the first quarter of 1996 to the last quarter of 2015; for South Africa, from first quarter of 1981 to the last quarter of 2015, and for India, from the third quarter of 1996 to the last quarter of 2014. The data has been taken from the International Financial Statistics (IFS).

1. OLS Regression model

The multiple linear regression models and its estimation using ordinary least squares (OLS) is the most widely used tool in the field of econometrics and finance. It explores the relationship between a set of independent variables with a dependent variable. According to Madura (2006), also shown in figure 1, the change in the exchange rate is due to the change in GDP growth, Inflation rate as well as interest rates. The statistical model for this study is:

$$\text{Exchange rate} = \alpha_0 + \alpha_1 \text{CPI} + \alpha_2 \text{GDP} + \alpha_3 \text{Interest rate} + \mu_t \quad (1)$$

where α_0 a constant is term and μ_t is an error term.

2. Auto Regressive (AR) Process

The effect of autocorrelation cannot be ignored while modeling macroeconomics. Therefore, in this study, we used the autoregressive of order 1 e.g., AR (1) to analyze the data which eliminates the autocorrelation from the estimated regression modelie, like [Abbas, et al. (2015)] used to estimate the model.

An AR (1) process can be presented as:

$$y_t = \mu + \phi y_{t-1} + u_t \quad (2)$$

where μ_t are errors.

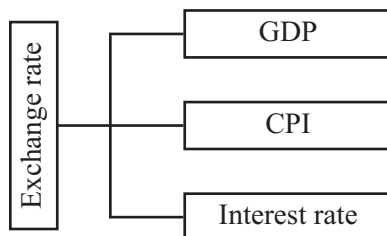


FIGURE 1

Conceptual Frame work

3. *Granger Causality test*

A statistical time series test for assessing the one time series variable is beneficial for the purpose of forecasting of another time series variable. The granger causality test was first proposed in the year 1969. This test depends on the multiple regression analysis [Goebel, et al. (2003) and Londei, et al. (2009)]. According to the Runes (1962), a causal relationship among variables means the first variable has the efficacy to produce or alter another. The granger causality test confirms the long run relationship of inflation, GDP growth and interest rate with the exchange rate. Hence, it is an alternate source for the simple correlation.

4. *Panel data analysis*

The Panel data is a dataset in which the behavior of entities is observed across time. It controls the variables which are hidden or unobserved that fluctuates time to time but not across entities. From the literature, it is found that the panel data modelling has progressed from the development of standard static fixed effect and random effect models in the early 2000's [Seetaram and Petit (2012)]. These techniques yield reliable estimate as compare to other complicated techniques. When the individual variables are observed in a different number of time then this is simply known as the unbalanced panel i.e. due to some missing values in the data set. Generally, to analyze the panel data, two models are used to estimate. The Fixed effect model can be written as follow:

$$y_{it} = \alpha + \beta x_{it} + \mu_{it} \quad (3)$$

where α is the unknown intercept, y_{it} is the dependent variable where i = entity and t = time, x_{it} is independent variable and β is the coefficient for that independent variable. μ_{it} is the error term.

To decide which model is better for the panel data analysis is to use a Hausman test where the null hypothesis is that the random effects model is appropriate than the fixed effects model [see, Green (2008) chapter 9].

V. **Empirical Results**

1. *Descriptive Statistics*

The descriptive statistics can be seen in Table 1. Japan is the country who has the highest inflation 101.84 among all other countries. Therefore, inflation of Japan has the highest rate of changes among all countries whereas the mean value of inflation of India and South Africa 84.43 and 81.53 respectively have lowest rate of changes.

The maximum value of standard deviation of inflation is 32.45 of India, which represents that it is more at risk to turn as against the expected value. Exchange rate of Japan has the highest rate of changes among all countries the maximum value of standard deviation of exchange rate is 14.27 of Japan, which indicates that it is more at risk to turn as against the expected value. GDP growth of India has the highest rate of changes among all countries. The maximum value of standard deviation of GDP growth belongs to India and Brazil, which shows that it is more at risk to turn as against the expected value. Interest rate of UK has the highest rate of changes among

TABLE 1
Descriptive Statistics

Country	Brazil	Canada	India	Japan	South Africa	UK
<u>Inflation</u>						
Mean	82.812	92.832	81.435	101.484	81.537	92.292
Median	82.505	93.360	68.309	101.000	73.680	88.651
Maximum	142.871	109.244	151.445	104.300	132.218	112.168
Minimum	43.199	76.445	42.002	99.300	43.941	77.106
Std. Dev.	28.236	10.210	32.451	1.410	26.064	11.622
Skewness	0.296	-0.049	0.779	0.426	0.385	0.484
Kurtosis	2.021	1.720	2.295	1.810	1.902	1.793
<u>Exchange Rate</u>						
Mean	2.117	1.251	47.353	108.778	7.775	0.611
Median	2.044	1.228	45.701	110.582	7.369	0.620
Maximum	3.842	1.594	65.924	139.954	14.205	0.703
Minimum	1.013	0.968	35.647	77.324	4.470	0.489
Std. Dev.	0.641	0.201	7.236	14.537	2.073	0.053
Skewness	0.464	0.172	0.905	-0.541	0.785	-0.516
Kurtosis	3.086	1.585	3.392	2.700	3.370	2.637
<u>GDP Growth</u>						
Mean	0.634	0.617	1.667	0.163	0.702	0.522
Median	0.877	0.699	1.676	0.296	0.772	0.637
Maximum	3.595	1.812	5.803	2.655	1.795	1.607
Minimum	-4.093	-2.285	-1.846	-4.090	-1.555	-2.253
Std. Dev.	1.283	0.641	1.018	1.074	0.586	0.602
Skewness	-0.913	-1.494	0.265	-1.171	-0.774	-2.338
Kurtosis	4.453	7.697	6.537	6.088	4.555	10.802
<u>Interest Rate</u>						
Mean	6.565	2.868	7.381	0.325	9.734	3.768
Median	6.208	3.000	6.500	0.300	8.500	4.581
Maximum	16.858	6.000	12.000	0.750	21.850	7.624
Minimum	1.820	0.500	6.000	0.100	4.953	0.485
Std. Dev.	2.768	1.675	1.649	0.199	4.173	2.449
Skewness	1.641	0.188	1.003	0.636	0.870	-0.214
Kurtosis	6.727	1.748	3.251	2.529	2.974	1.532

all countries. The maximum value of standard deviation of interest rate belongs to UK, which represents that it is more at risk to turn as against the expected value.

2. *Pairwise Correlation*

The pairwise correlation is shown in the Table 2. According to findings, the correlation between the exchange rate and other variables are approximately moderate for the developing country Brazil. Furthermore, the results indicate that there is a positive impact of inflation and interest rate on the exchange rate of Brazil. Similarly, the correlation between the inflation and exchange rate of remaining de-

TABLE 2
Results of Pairwise Correlation

	Exchange rate	Inflation	GDP growth	Interest rate
<u>Brazil</u>				
Exchange rate	1.000			
Inflation	0.381	1.000		
GDP growth	-0.215	-0.179	1.000	
Interest rate	0.288	-0.154	-0.111	1.000
<u>Canada</u>				
Exchange rate	1.000			
Inflation	0.286	1.000		
GDP growth	0.018	-0.206	1.000	
Interest rate	0.008	-0.644	-0.040	1.000
<u>India</u>				
Exchange rate	1.000			
Inflation	0.862	1.000		
GDP growth	0.054	0.099	1.000	
Interest rate	0.059	0.058	-0.224	1.000
<u>Japan</u>				
Exchange rate	1.000			
Inflation	-0.926	1.000		
GDP growth	0.330	-0.341	1.000	
Interest rate	0.830	-0.743	0.261	1.000
<u>South Africa</u>				
Exchange rate	1.000			
Inflation	0.946	1.000		
GDP growth	-0.020	-0.012	1.000	
Interest rate	-0.140	-0.233	-0.300	1.000
<u>UK</u>				
Exchange rate	1.000			
Inflation	0.146	1.000		
GDP growth	0.106	-0.101	1.000	
Interest rate	-0.338	-0.901	-0.080	1.000

veloping countries India and South Africa is strong and positive. The correlation between the exchange rate and inflation of Canada is moderate and positive. While there is a moderate and negative correlation has been found between the exchange rate and interest rate of UK. Japan is the only developed country in this study which shows the strong and positive correlation between the exchange rate and interest rate. On the other hand, the correlation between the exchange rate and inflation is strong but negative. This reveals that due to high rate in inflation, the exchange rate of Japan is not stable.

3. *Granger causality test*

The result of Granger causality test is presented in Table 3. All the macroeconomic variables are considered to be independent with each other in Granger causality test. The result shows the causal relationship is present between the GDP growth, inflation, interest rate and exchange rate. For developed countries such as Japan, the inflation has a bidirectional causal relationship with exchange rate. It is also found that exchange rate has unidirectional causal linkage with GDP growth and interest rate. For the Canada, there is no macroeconomic variable which has a causal relationship with exchange rate. Moreover, there is a unidirectional causal relationship present between the interest rate and exchange rate for the country UK. For the developing countries, there is a unidirectional causal relationship present between the exchange rate and all other macroeconomic variables for Brazil. While, for the South Africa, it is found that the inflation has a bidirectional causal relationship with the exchange rate. At last, there is a strong unidirectional causal relationship present between the interest rate and exchange rate for the developing country India.

4. *Empirical Results for Developed Countries*

a) *Canada*

The OLS regression estimates are given in Table 4. According to the findings, the co-efficient of inflation has negative and significant impact on exchange rate. Hence, there is an inverse relationship present between exchange rate and inflation. The other two macroeconomic variables have no significant impact on the exchange rate for Canada. From the t-statistics value the GDP growth and interest rate have insignificant effect on exchange rate. Furthermore, Table 4 also shows the R square values for each and every estimated model. The R square expresses the strength of linear relation among two macroeconomic variables by coefficient of correlation. The value of R² is 0.967 which means that 96 per cent deviation affected through explanatory variables on the explained variable.

TABLE 3
Granger Causality Test Result

Null Hypothesis	F-Stats	P-value	Null Hypothesis	F-Stats	P-value
<u>Japan</u>			<u>Brazil</u>		
Inflation does not Granger Cause E	2.916	0.057	Inflation does not Granger Cause E	2.307	0.103
E does not Granger Cause inflation	5.150	0.007	E does not Granger Cause inflation	4.371	0.015
GDP growth does not Granger Cause E	0.176	0.839	GDP growth does not Granger Cause E	0.075	0.928
E does not Granger Cause GDP growth	6.629	0.002	E does not Granger Cause GDP growth	3.704	0.029
I does not Granger Cause E	1.879	0.156	I does not Granger Cause E	0.309	0.735
E does not Granger Cause I	3.180	0.044	E does not Granger Cause I	4.098	0.019
GDP growth does not Granger Cause inflation	0.369	0.692	GDP growth does not Granger Cause inflation	0.943	0.394
Inflation does not Granger Cause GDP growth	6.647	0.002	Inflation does not Granger Cause GDP growth	1.989	0.144
I does not Granger Cause inflation	26.986	0.000	I does not Granger Cause inflation	6.185	0.003
Inflation does not Granger Cause I	4.870	0.009	Inflation does not Granger Cause I	6.378	0.002
I does not Granger Cause GDP growth	5.207	0.006	I does not Granger Cause GDP growth	1.115	0.334
GDP growth does not Granger Cause I	2.371	0.096	GDP growth does not Granger Cause I	1.003	0.372
<u>Canada</u>			<u>SAF</u>		
Inflation does not Granger Cause E	0.257	0.773	Inflation does not Granger Cause E	4.590	0.011
E does not Granger Cause inflation	0.912	0.403	E does not Granger Cause inflation	3.179	0.044
GDP growth does not Granger Cause E	0.499	0.608	GDP growth does not Granger Cause E	0.023	0.977
E does not Granger Cause GDP growth	0.818	0.443	E does not Granger Cause GDP growth	0.712	0.492
I does not Granger Cause E	0.027	0.974	I does not Granger Cause E	0.216	0.806
E does not Granger Cause I	2.057	0.131	E does not Granger Cause I	0.937	0.394
GDP growth does not Granger Cause inflation	0.350	0.705	GDP growth does not Granger Cause inflation	0.122	0.885
Inflation does not Granger Cause GDP growth	2.335	0.100	Inflation does not Granger Cause GDP growth	0.667	0.515
I does not Granger Cause inflation	8.470	0.000	I does not Granger Cause inflation	4.773	0.010
Inflation does not Granger Cause I	3.682	0.027	Inflation does not Granger Cause I	1.103	0.334
I does not Granger Cause GDP growth	1.707	0.184	I does not Granger Cause GDP growth	5.904	0.003
GDP growth does not Granger Cause I	8.600	0.000	GDP growth does not Granger Cause I	5.606	0.004
<u>UK</u>			<u>India</u>		
Inflation does not Granger Cause E	0.372	0.690	Inflation does not Granger Cause E	1.936	0.147
E does not Granger Cause inflation	1.934	0.150	E does not Granger Cause inflation	0.947	0.390
GDP growth does not Granger Cause E	2.200	0.114	GDP growth does not Granger Cause E	2.176	0.121
E does not Granger Cause GDP growth	1.881	0.155	E does not Granger Cause GDP growth	3.109	0.051
I does not Granger Cause E	5.189	0.007	I does not Granger Cause E	1.308	0.273
E does not Granger Cause I	0.081	0.922	E does not Granger Cause I	10.475	0.000
GDP growth does not Granger Cause inflation	2.208	0.115	GDP growth does not Granger Cause inflation	2.128	0.127
Inflation does not Granger Cause GDP growth	1.445	0.241	Inflation does not Granger Cause GDP growth	0.378	0.687
I does not Granger Cause inflation	2.872	0.061	I does not Granger Cause inflation	1.055	0.351
Inflation does not Granger Cause I	9.927	0.000	Inflation does not Granger Cause I	1.388	0.252
I does not Granger Cause GDP growth	0.937	0.394	I does not Granger Cause GDP growth	1.527	0.224
GDP growth does not Granger Cause I	5.396	0.006	GDP growth does not Granger Cause I	1.043	0.358

Note: E stands for exchange rate and I stands for interest rate in the above Table.

b) Japan

Our findings revealed that there is a strong, positive and significant impact of interest rate on exchange rate. While there is no significant impact on exchange rate found by GDP growth and inflation. It is quite different with the results of McPherson, et al. (2000) in which they proved that there is no impact of GDP growth and interest rate on the exchange rate fluctuations. The value of R² is 0.98 which mean 98 per cent deviation caused through the explanatory variables on the explained variable.

c) UK

According to the results (Table 4), inflation and interest rate of UK have strong and negative impact on exchange rate; hence, there is an inverse relationship found between these macroeconomic variables. The value of R² is 0.80 which means 80 per cent deviation produced through explanatory variables on the explained variable.

5. Empirical Results for Developing Countries

a) Brazil

Surprisingly, according to the findings, the impact of all three macroeconomic variables GDP growth Inflation and interest rate have no significant impact on the exchange rate at 5 per cent level of significance for Brazil. The value of R² is 0.91 which means that 91 per cent deviation caused through explanatory variables on the explained variable. Therefore, for Brazil, there is no role of all these three variables on the fluctuations of the exchange rate of the country.

b) South Africa

The result shows that there is a strong, positive and significant impact of inflation on the exchange rate. Moreover, the results also revealed that the exchange rate may also be affected by the ups and downs in the interest rate of South Africa. The value of R² is 0.987 which mean 98 per cent deviation caused through descriptive variables on explain variable.

c) India

Our findings also revealed that India is the country in which strong positive and significant relationship exist between the inflation and the exchange rate. It seems that as the fluctuations in the exchange rate of India, strongly influence by

the variation in the inflation. Remaining two macro-economic factors GDP growth and interest rate has no significant impact on the exchange rate. The value of R2 is 0.962 which mean 96 per cent deviation caused through descriptive variables on explain variable.

TABLE 4
Results of Ordinary Least Square Estimation

Variable	Coefficient	Std. Error	t-Stats	P-value	R-squared	Adjusted R-squared	F-stats	P-value (F-stats)
<u>Canada</u>								
Inflation	-0.014	0.005	-2.663	0.009	0.967	0.966	1311.740	0.000
GDP growth	-0.003	0.003	-1.372	0.172				
Interest rate	0.002	0.002	1.011	0.313				
Constant	4.336	3.164	1.371	0.172				
AR(1)	0.996	0.005	204.193	0.000				
<u>Japan</u>								
Inflation	0.786	0.946	0.831	0.407	0.989	0.989	4093.400	0.000
GDP growth	0.182	0.427	0.426	0.670				
Interest rate	4.504	1.391	3.237	0.001				
Constant	19.702	107.771	0.183	0.855				
AR(1)	0.978	0.007	134.783	0.000				
<u>UK</u>								
Inflation	-0.003	0.001	-2.402	0.018	0.807	0.800	110.699	0.000
GDP growth	-0.001	0.005	-0.172	0.864				
Interest rate	-0.014	0.004	-4.018	0.000				
Constant	0.957	0.125	7.661	0.000				
AR(1)	0.851	0.050	16.983	0.000				
<u>Brazil</u>								
Inflation	0.027	0.019	1.380	0.172	0.917	0.913	202.338	0.000
GDP growth	-0.024	0.014	-1.733	0.087				
Interest rate	-0.003	0.018	-0.171	0.864				
Constant	-0.029	2.602	-0.011	0.991				
AR(1)	0.973	0.032	30.889	0.000				
<u>South Africa</u>								
Inflation	0.093	0.012	7.924	0.000	0.987	0.987	3393.934	0.000
GDP growth	-0.002	0.027	-0.071	0.944				
Interest rate	0.050	0.027	1.864	0.064				
Constant	-0.081	0.885	-0.092	0.927				
AR(1)	0.945	0.027	34.584	0.000				
<u>India</u>								
Inflation	0.239	0.062	3.875	0.000	0.962	0.960	454.813	0.000
GDP growth	0.017	0.123	0.136	0.892				
Interest rate	0.136	0.275	0.495	0.622				
Constant	27.769	6.566	4.229	0.000				
AR(1)	0.935	0.047	20.073	0.000				

Panel Data Analysis

We used the unbalance panel data analysis technique. The fixed effects and random effects models were estimated. After estimation, the Hausman test is applied. According to the Hausman test Table 5, the fixed effects model is appropriate as compare to the random effects model. According to the results, all the three macroeconomic variables i.e. GDP growth, Inflation and interest rate have a strong and significant impact on the exchange rate fluctuations Table 6. The results of fixed effects model are more reliable as compare to other OLS techniques. The value of R² is 0.80 which mean that 80 per cent deviation caused through the descriptive variables on the explained variable.

VI. Conclusion

There are many macroeconomic variables which are responsible for the fluctuations in the exchange rate both for developed and developing countries, This study is quite different from other studies as the previous studies found the impact of macroeconomic variables on industrialized developed countries or on only developing and under developing countries. This study explores the relationship of exchange rate with some very important macroeconomic variables which plays a key role in the fluctuation in exchange rate for not on the developed countries but also three developing countries which are expected to be the biggest economy powers in the future.

The role of exchange rate is very important in the economy for the whole world [Samea, et al. (2014)]. It has been observed that by controlling the variations of these macroeconomic variables, any country can make boost the value of their cur-

TABLE 5

Correlated Random Effects - Hausman Test

Variable	Coefficient	Std. Error	t-Stat.	P-Value	R-Squared	Adjusted R-squared	F-Stat	P-value (F-stat.)
GDP growth	7.055	1.274	5.538	0.000	0.802	0.800	411.799	0.000
Inflation	-0.196	0.048	-4.135	0.000				
interest rate	2.453	0.371	6.605	0.000				
C	36.482	5.335	6.839	0.000				

TABLE 6

Test Cross-section Random Effects

Test Summary	Chi-Sq. Statistic	P-value
Cross-section random	4.992738	0.1723

rency. A falling in the exchange rate almost drops the purchasing power parity capital gains. There are many positive and negative consequences about the fluctuations in the exchange rate regarding the impact of macroeconomic variables on the exchange rate. We consider these three independent macroeconomic variables, i.e., Inflation, GDP growth and interest rate because they have a strong influence on the exchange rate but at the same time, from the previous literature, the findings are also inconclusive. We examine the relationship which also clarifies the relationship of these variables. We found that in developed countries i.e. UK and Japan, interest rate is the only macroeconomic variable which has a significant relation with exchange rate while there is no significant relationship present between the other two variables i.e. Inflation and GDP growth. Also, for Japan, there is a strong and positive correlation found between the exchange rate and interest rate but Inflation has negative correlation with exchange rate. For Canada, the Inflation has a very strong and positive impact on the exchange rate. Moreover, South Africa and India are the developing countries in which there is a significant relationship present between the Inflation and the exchange rate. These results can be verified by the correlation results between the Inflation and exchange rate which are found to be strong and positive. Also, there is no significant impact of any macroeconomic variable found on the exchange rate for the Brazil but the correlation between the exchange rate and other variables are found to be approximately moderate.

Finally, the pair wise granger causality test also revealed the causal relationship of exchange rate with GDP growth, Inflation and interest rate for all the countries. For Japan, GDP growth, Inflation and interest rate has a causal relationship with exchange rate. Hence, a long run relation found by which the forecast of the exchange rate could be accurate. At the same time, there is no causal relationship found for the Canada. Moreover, there is a causal relationship has found between the interest rate and exchange rate for the country UK. For Brazil, there is a unidirectional causal relationship present between the exchange rate and all other macroeconomic variables. While, for the South Africa, it is found that inflation has causal relationship with the exchange rate. But interest rate has a causal impact on exchange rate for the developing country India. Overall, it can be concluded from all the findings in this study that there is a strong influence of inflation, GDP growth and interest rate on the fluctuation of exchange rate from both the developed and developing countries.

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