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An Analysis of the Behavioural Pattern of Indian Rupee and Chinese Yuan vis-a-vis US Dollar.

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Abstract
This paper examines the temporal behaviour of the exchange rate of Indian Rupee and Chinese Yuan per US Dollar. Both currencies needed an estimation of best-fit equation out of nineteen alternative functional forms using AIC Criteria. The study revealed that the Indian Rupee is more sensitive to USD in comparison to Chinese Yuan. The values of relative growth rates indicate that a turning point was observed in the beginning of 2013 for Indian Rupee. However, relative growth rates of Chinese Yuan have increased successively without any perceptible turning point. The paper observed different behaviour of both the currencies.

Keywords: Indian Rupee, Chinese Yuan, Relative Growth Rates, Temporal Behaviour.
JEL Classification Code: F3, F21, F32.

I. Introduction

Exchange rate behaviour has drastically altered from a less volatile position to a highly volatile position in the post Bretton Woods era. The reason being that after the collapse of Bretton Woods, flexible exchange rate system has been implemented worldwide and due to the introduction of this new exchange rate structure, one of the key concerns has been whether exchange rate volatility subsequent to this, would cause macroeconomic instability. All swings as well as movements that cause a currency to appreciate or depreciate due to variation in the price of one currency in terms of another currency are said to be volatility or fluctuations in exchange rate. Due to unanticipated variations in exchange rate level driven by movements in fundamental macroeconomic variables, exchange rates become generally more volatile. These variations in exchange rate significantly impact the size of foreign investment portfolios, the value for international reserves, the competitiveness of goods being imported and exported, debt repayments in other currencies and the cost to tourists for travelling internationally (Dua and Ranjan, 2011).

Indian Rupee was related to the British sterling at the time of country's independence in 1947 and its value was at par with the American dollar. At that time there was absence of international debt and borrowing on India's balance sheet. With the execution of Five-Year Plan in 1951, the government began external borrowing to fund welfare and growth programs in the economy. At the outset, India implemented a fixed exchange rate regime system after independence. Between 1948 and 1966, the Rupee was pegged at 4.79 against one dollar. As India has consistently experienced trade and government budget deficits, the country has earned substantial financial assistance from foreign institutions. India has been running continuous trade deficits since 1950, which grew in magnitude in the 1960s. Except for the year 1958, foreign aid always remained lower than India's overall trade deficit in the period from 1950 to 1966. Foreign assistance was important enough to delay the final devaluation of the Rupee until 1966. This foreign aid was eventually cut off in 1966 and India was asked to liberalise its trade controls so that foreign aid could be sanctioned again. The situation again deteriorated when Indian government was in deep economic trouble at the end of 1990 and its foreign exchange reserves had virtually dried up to the extent that India could barely fund its imports beyond three weeks. Thus, in 1991, India faced acute balance of payment crisis and was compelled to devalue its currency sharply. Consequently, against one US dollar, the currency was devalued to Rs 17.90 i.e., almost 19% devaluation and thereafter Indian government agreed to liberalise its economy in 1991 by itself.

Since then, Indian Rupee followed a depreciating journey and at present Rupee has declined to Rupees 83.29 per one USD as on October 20, 2022 and this decline has been observed as all time low. Indian currency has been observed as losing its value over the past five years more rapidly but it has been the year of 2022 which experienced greatest decline of Rupee among all.

Since the breakdown of the Bretton Woods System of Fixed Parities in 1971, exchange rate volatility has been a regular feature of the International Monetary System (Black and Scholes, 1973). In recent years, international financial markets and exchange rate values of the currencies of different nations have been reported to have got integrated to quite an extent. On one hand, the collapse of Bretton Woods System in the early 1970s has resulted in very wide fluctuations in the exchange rates of different currencies while, on the other hand, the financial liberalisation in early 1990s has induced voluminous promotion in FDI and FII etc. (Lingaraja et al., 2014, 2015). Due to the dynamic performance of different economies, the relative position of the values of their currencies are not expected to remain static. A knowledge of the relative position the currencies among a given group of nations at a given point of time can possibly provide useful policy input to adopt suitable corrective measures at the macro level. Under this backdrop, an attempt has been made in this paper to examine the relative position of Indian Rupee vis-a-vis Chinese Yuan.

It may be mentioned that for certain currencies, some of the equations remained inestimable due to non-conformability of the available dataset with such equations. From amongst the other estimable equations, choice of the best-fit equation was made on the basis of Akaike's Information Criterion (AIC); the functional form associated with the minimum value of AIC was accepted to be the best-fit equation for the given currency.

On the basis of the so-chosen best-fit equation, relative growth rates (RGR_t) values were estimated as, $RGR_t = \frac{\Delta Y_t}{\hat{Y}_t}$,where ΔY_t signifies changes in time variable Y and $\hat{Y}_t$ indicates the computed value of Y at time t.

II. Review of Literature

In order to formulate the problem, a dive into the literature already available in the sphere of currency exchange rate is the prerequisite. Thus, an attempt is being made to present the studies on the currency exchange rate variations in chronological order as below:

Sundararajan (1992) analysed the impact of capital flows on exchange rate behaviour based on portfolio equilibrium model and macroeconomic model of Kouri and Porter (1974). The study focussed on an in-depth analysis of capital flows to India and their impact on exchange rate swings from 1960-61 to 1984-85. The study supported a strong association of trade openness and portfolio capital inflows. These trade flows being linked with capital inflows have an impact upon exchange rate fluctuations.

Khatkhate (1998) explored the major currencies such as United States dollar, Japanese yen and German deutschmark, particularly the US dollar, which has fluctuated more frequently in the recent years. This volatility has a substantial bearing on the emerging countries and their foreign exchange management. The main reason behind this is that these countries are open both on capital and current account which tend to destabilise macroeconomic system due to capital inflows especially in the form of Foreign Institutional Investors' (FIIs) investment. The problem further gets aggravated when a developing nation follows fixed exchange rate regime. Consequently, the current account deficit of developing nations gets enlarged and the currency depreciates vis-a-vis US dollar.

Kia (2013) established a theoretical monetary model of real exchange rate of Canadian economy and showed that real exchange rate is a function of real money supply, domestic and international interest rates, real GDP, real government spending, domestic and foreign externally financed debt per GDP, deficit per GDP, commodity price, domestic and foreign outstanding debt per GDP over the long term. Among G7 countries; Canada has the highest degree of transparency and has therefore strong grounds for testing this model. Over the quarterly period of 1972-2010, the co-integration test results indicate that long run relationship is detected between the exchange rate and its determinants considered. Thereafter, short run relationship among the cointegrating vector was specified by applying error correction model. The approximate coefficients of all error correction terms (ECMs) were used to evaluate the effect of shocks on domestic variables on the real exchange rate, taking into account the relevant impulse responses. The real exchange rate has appreciated by the shocks to the interest rate, deficit and debt per GDP and price of goods whereas depreciated due to real government spending and foreign-financed debt per GDP as a shock.

Kadyan (2014) made an attempt to have insight into the Indian Rupee's present position as an internationally recognized currency. For this purpose, the author examined the distinct features of Indian Rupee as international currency. These characteristics have been divided into five categories such as pegging currency, invoicing currency, hand to hand currency, currency for international financial market and reserve or government intervention currency. These features have been empirically analysed one by one for determining current position of Indian Rupee as a global currency. The results revealed that Indian Rupee is not a currency of international trade invoicing since most of Indian trade transactions are being held in US dollars. The Rupee is also recognised as the most volatile currency and this is particularly because of the piling up of huge current account deficit, rising inflation and high volume of fiscal deficit of India. As a consequence of these factors, the confidence of the investors and other international participants in Indian Rupee is eroding continuously. Moreover, it is not currently fully convertible currency. All these indicates that currently Indian Rupee is not an international currency.

Ojo and Alege (2014) empirically investigated exchange rate fluctuations and critical determinants along with the output using panel data set consisting of 40 Sub-Saharan African (SSA) countries covering a period from 1995-2007. This is a dynamic panel data model that enabled to manage bias resulting from endogeneity and omitted variables. For examining time series characteristics, panel unit root test and panel cointegration test have been applied, which detected that long-run relationship exists for the series taken. Also, the bidirectional causality among exchange rate and consumer prices index; the interest rate and openness has been observed by the Panel Granger causality test. Further, residual diagnostic tests have been conducted at the end which confirmed the stability of models. The results reflected a clear exogeneity among exchange rate and its determinants i.e., real GDP, government spending and foreign direct investment.

Patosa and Cruz (2015) employed the real interest differential (RID) model which is backed by the price theories of Keynesian and Chicago. This study highlighted patterns and scrutinised the determinants of exchange rate movements with United States as the base country in five selected Asian nations - Malaysia, Thailand, Singapore, China and Philippines considering United States dollar as the base currency from 1977 to 2010. Using ordinary least square (OLS) regression, both long and short-run dynamics among the considered variables for exchange rates has been estimated. For all the sample countries, industrial production has turned significant while results were mixed for three other variables: money supply, interest rate and inflation rate. Industrial production and the inflation rate were significant variables for China and Malaysia. Industrial production and interest rates for Thailand and money supply and industrial production for Singapore were statistically significant. Author further emphasised that three variables i.e., money supply, industrial production and interest rate in the Philippines contributed significantly towards exchange rate movements.

Chaudhary et al. (2016) verified the behavioural trends for the Asian countries comprising of India, Pakistan, Bangladesh and Sri Lanka from South Asian zone and for South east economies consisting of Malaysia, Singapore, Indonesia and Thailand. For analytical purpose, exports and imports has been expressed in billions of the respective nation's currencies. While calculating nominal exchange rate, US dollar has been taken as reference currency for all considered nations. The long-run ARDL co-integration model and dynamic error correction equation is being used for exploring long-term and short-term causality between exports and exchange rate, imports and exchange rate covering a period of 1979-2010. The study concluded that there exists cointegration in exchange rate and exports of Pakistan, Sri Lanka, India, Bangladesh and Indonesia. Moreover, study summarized that long run association between exchange rate and imports could only be found for Sri Lanka. In addition, the error correction vector has turned insignificant in all economies except Sri Lanka and Bangladesh. Thus, any disequilibrium between exports and exchange rate and also imports and exchange rate is not corrected by short-run drivers.

Raza and Afshan (2017) explored exchange rate determinants of Pakistan economy employing time series from the year 1972 to 2013. For empirical estimations, ARDL bound test, the Johansen-Juselius co-integration approach and the structural break co-integration approach of Gregory and Hansen have been applied. Long-term estimations suggested a strong negative relation of exchange rates economic growth, trade openness and terms of trade. In contrast, money supply and inflation rate have favourable impact on exchange rates. The short run behaviour of undertaken variables has been analysed through error correction model. The evaluations signify that terms of trade and trade openness have significantly negative relationship with Pakistani Rupee and thus contribute towards long-run equilibrium. Granger causality results exhibited that exchange rate has bidirectional causal relationship with trade openness and economic growth. However, the unidirectional causality runs from the explanatory variable, i.e., inflation, money supply and terms of trade to the exchange rate. The sensitivity analysis results further confirmed the preceding long run results.

Kumar and Patnaik (2018) argue that currently the Indian Rupee has a share of approximately 1% in foreign exchange transactions at the global level. In contrast to the top eight emerging market currencies, it has a lesser market share across the broad spectrum of trading platforms. The authors assessed the Indian Rupee's present position as an international currency and also analysed the prospects for its future in relation to internationalization of Indian Rupee currency. The study examined the distinctive features of Indian Rupee as an international currency. It has been discovered that the Indian Rupee plays merely a marginal role as a currency of the official sector. In comparison to the official sector, private sector acceptance of the Indian Rupee is significantly larger and more widespread. However, this function is primarily limited to investing in investment portfolios and financial flows. Due to several challenges in the way of Indian currency conversion and management of risks involved therein, Indian Rupee has a limited role in exports and imports invoicing and payments in the private sector.

Zerihun et al. (2019) claimed that the BRICS countries' currencies have recently experienced phases of decline with high level of uncertainty. For analysing the volatility in currencies of BRICS nations, the author applied exchange rate observations spanning over January 1995 to January 2017. To evaluate the causal relationship among the currencies of BRICS nations, bivariate Granger causality approach, GARCH (1,1) volatility framework and Pearson coefficient correlation have been applied. The findings demonstrated that China, India and Brazil all are generally more competitive in comparison to South Africa while South Africa is just marginally competitive than Russia only. The results also revealed that when compared to the Russian ruble and Brazilian real, the South African's rand has become more volatile although it is not as volatile as the Indian Rupee and Chinese renminbi. The Russian ruble has been found to be the least volatile currency among all the BRICS currencies with the exception of an unexpected and sharp rise in year 1999. It is subsequently followed by the Brazilian real, South African's rand, Indian Rupee and Chinese renminbi in relation to volatility. Further, the renminbi, ruble, real and rand all exhibited correlation in their inter-currency volatility. The paper also discovered that the volatility of the renminbi returns has a direct causal effect on the volatility of the real, ruble and rand returns. Finally, the study inferred that Brazilian real is the currency that has been discovered as most susceptible and vulnerable.

It could be observed on the basis of the review of studies as presented above that there exists a gap of comparative analysis of currencies falling under Asian region. The present paper is an effort to address this gap and compare the two most prominent currencies of the Asian zone namely, Indian Rupee and Chinese Yuan.

Objectives of the Study

Considering the above literature review and foregoing discussion, the current paper will focus on attaining the following objectives:

1. To make a comparative study of relative growth rates of Indian Rupee and Chinese Yuan exchange rate vis-a-vis US dollar.
2. To identify the turning points if any in the relative growth rates of Indian Rupee and Chinese Yuan exchange rate.

Data Description and Methodology

For both economies i.e., India and China, month-wise time series data (with 243 observations, from January 2001 through March 2021) were considered on national currency per USD from different secondary sources (like Federal Reserve Bank of St. Louis, International Monetary fund etc). For studying long-term growth behaviour of exchange rates of each of the currencies, an attempt has been made (by following Sethi, 2008, 2010) to estimate the following 19 trend relationships in time variable t:

1. Simple Linear (SLNR) : [Estimated through OLS method]

2. Parabolic (PRBL) : [Estimated through OLS method]

3. Cubic (CUBC) : [Estimated through OLSmethod]

4. Exponential (EXPN) : [Estimated through OLS method]
5. Exponential (NLEX) : [Estimated through NLS method]

6. Exponential Parabolic (EPRB) : [Estimated through OLS method]

7. Exponential Parabolic (NLEP) : [Estimated through NLS method]

8. Exponential Cubic (ECUB) : [Estimated through OLSmethod]
9. Exponential Cubic (NLEC) : [Estimated through NLS method]

10. Geometric (GMTC) : [Estimated through OLS method]
11. Geometric (NLGM) : [Estimated through NLS method]

12. Hyperbolic (HYPR) : [Estimated through OLS method]
13. Hyperbolic (NLHP) : [Estimated through NLS method]

14. Modified Exponential (MEXP) : [Estimated through 'Partial Sums' method]
15. Modified Exponential (NLME) : [Estimated through NLS method]
16. Gompertz (GOMP) : [Estimated through 'Partial Sums' method]
17. Gompertz (NLGP) : [Estimated through NLS method]
18. Logistic (LGST) : [Estimated through 'Partial Sums' method]
19. Logistic (NLLG) : [Estimated through NLS method]

For each of the estimated equation, Akaike's Information Criterion (AIC) were computed. The function associated with the least value of AIC was accepted to be the equation of the best-fit (EBF).

EBF	Estimated Equation	RGR_t
PRBL	$\hat{Y}_t = b_0 + b_1 t + b_2 t^2$	$RGR_t = \frac{b_1 + 2b_2 t}{b_0 + b_1 t + b_2 t^2}$
CUBC	$\hat{Y}_t = b_0 + b_1 t + b_2 t^2 + b_3 t^3$	$RGR_t = \frac{b_1 + 2b_2 t + 3b_3 t^2}{b_0 + b_1 t + b_2 t^2 + b_3 t^3}$
EPRB or NLEP	$\hat{Y}_t = b_0 b_1^t b_2^{t^2}$	$RGR_t = \ln(b_1) + 2\ln(b_2)t$
ECUB or NLEC	$\hat{Y}_t = b_0 b_1^t b_2^{t^2} b_3^{t^3}$	$RGR_t = \ln(b_1) + 2\ln(b_2)\,t + 3\ln(b_3)\,t^2$
LGST or NLLG	$\hat{Y}_t = \frac{k}{1 + b_0 b_1^t}$	$RGR_t = \frac{-(b_0 b_1^t)\ln(b_1)}{1 + b_0 b_1^t}$

From the identified EBF, relative growth rates (RGR_t) values for some of the equations of the best-fit were obtained as per above mentioned formulas. For each of the currencies, the computed values of RGR_twere plotted against time, so as to examine the nature of growth in the currencies.

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Estimation of Turning Points along the Path of Relative Growth Rates:

As per a simple approach indicated in Sethi (2010), a turning point was taken to have occurred at time 't' at which the change in relative growth rates (given by $\Delta RGR_t = RGR_{t+1} - RGR_t$) got reversed in sign. Specifically, a turning point was taken to have occurred at 't' with acceleration/ deceleration immediately thereafter if ΔRGR_t changed its sign from negative/ positive to positive/ negative. A non-reversal in the sign of ΔRGR_t implied the absence of turning point(s) along the path of relative growth rates. In such cases, there would be an acceleration, constancy or deceleration throughout the growth path, according as ΔRGR_t remained greater than, equal to or less than zero, respectively.

III. Results and Discussion

Temporal Behaviour of the Currency of India

In respect of the exchange rate of Indian Rupee (in terms of USD), all the 19 functional forms turned out to be estimable, Computations in respect of the different functional forms have been depicted in the Table-1:

Table-1. Estimations for the different Trend Paths for Indian Rupee Exchange Rate

Estimated Equation	Coefficients	Phi-Value	RMSE	AIC	BIC
SLNR	2	0.7724	5.104	796.182	803.169
PRBL	3	0.8987	3.405	601.533	612.013
CUBC	4	0.9335	2.759	**501.155**	515.128
EXPN	2	0.8103	4.667	752.742	759.728
NLEX	2	0.8166	4.581	743.699	750.685
EPRB	3	0.8721	3.827	658.292	668.771
NLEP	3	0.8793	3.716	643.980	654.459
ECUB	4	0.9333	2.763	501.925	515.897
NLEC	4	0.9337	2.754	510.354	514.326
GMTC	2	0.4396	8.036	1016.770	1023.756
NLGM	2	0.4797	7.718	997.140	1004.126
HYPR	2	0.0380	10.666	1154.413	1161.399
NLHP	2	0.0749	10.291	1136.980	1143.966
MEXP	3	0.7957	4.839	772.326	782.805
NLME	3	0.8670	3.901	667.605	678.085
GOMP	3	0.7049	5.821	862.083	872.562
NLGP	3	0.8623	3.970	676.058	686.537
LGST	3	0.4379	8.064	1020.495	1030.975
NLLG	3	0.8576	4.037	684.173	694.652

A glance at the table clearly reveals that the equation CUBC was relatedwith the least value (= 501.155) of the benchmark AIC and was, therefore, accepted as the best fit equation in the present case. This equation can be expressed as $\hat{Y} = b_0 + b_1 t + b_2 t^2 + b_3 t^3$, where b_0 refers to the constant term, while b_1, b_2 and b_3 denote respectively the first, second and the third-degree effects of time variable 't' on Indian Rupee (Y). The computations with regards to this equation have been given in Table-2:

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Table-2. Computations for Best-FitEquation -- India

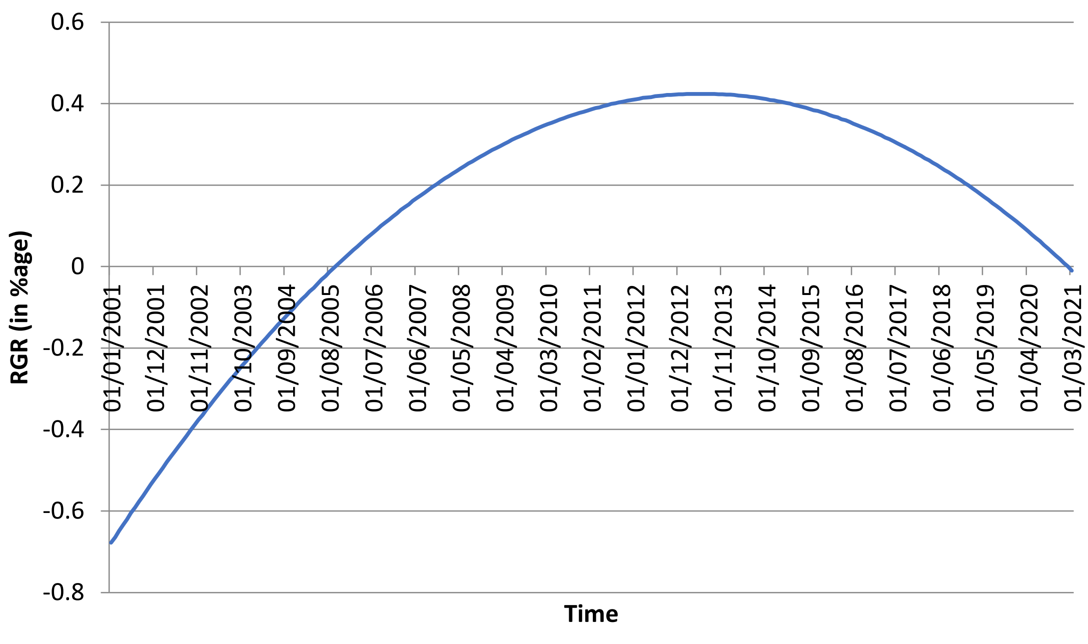
Parameters	Estimate	S.E. of Estimate	t-value	Prob.	Sig.
b_0	5.22E+01	7.25E-01	72.04	< 0.0001	*
b_1	-3.40E-01	2.57E-02	-13.26	< 0.0001	*
b_2	3.56E-03	2.44E-04	14.57	< 0.0001	*
b_3	-7.37E-06	6.58E-07	-11.19	< 0.0001	*

R^2 = 0.9335*; Adj R^2 = 0.9327; p = < 0.0001; AIC = 501.155
*: Significant at 1% level.

As per the Table-2, the intercept term (b_0) was highly significant, thereby signifying that the best-fit equation cut the Y-axis at 52.20 point which was significantly away from the origin.Furthermore, each of the coefficients b_1, b_2 and b_3 were observed to be statistically highly significant. For the EBF, the value of R^2 was high as 0.9335 implying that93.35 percent of the variations in the Indian Rupee was due to time variable 't' which is highly significant at 1% level of significance. The value of Adjusted R^2 was lower than R^2 that is 0.9327.

Moving on, on the basis of the coefficients of the EBF, values of RGR in the Indian rupee exchange rate were computed at different points of time andshown graphically in Figure-1. The figure is a clear indicative of a parabolic pattern in the RGR_t. A turning point was observed to have occurred in the beginning of the year 2013. Up to that point, the rates of growth kept rising (at diminishing rates) and started falling down subsequently (at increasing rates). It implies the vulnerability of Indian Rupee in response to fluctuations in USD. It can be said that this turning point of Indian Rupee in 2013 marks the severe depreciation since Indian Rupee was traded in the range of 45 to 50 from 2000-2010 and even it remained within a range of 54 to 57 from 2011 to 2013 but all of sudden Indian Rupee vis-a-via USD elevated these earlier ranges and instantly took a turning point with a value of 61.80 Rupee per USD.

Fig. 1. Temporal Pattern of RGRs for Indian Rupee



Temporal Behaviour of the Chinese Yuan

In respect of Chinese currency (in terms of USD), none of the asymptotic growth curves (viz., Modified Exponential, Gompertz or Logistic - whether estimated through the method of partial sums or through the non-linear approach) happened to be estimable, computations in respect of the different functional forms have been exhibited in Table-3:

Table-3. Estimations for the different Trend Paths for Chinese Yuan

Estimated Equation	Coefficient	Phi-Value	RMSE	AIC	BIC
SLNR	2	0.001	0.029	-1722.658	-1715.672
PRBL	3	0.181	0.026	**-1769.019**	-1758.540
CUBC	4	0.181	0.026	-1767.070	-1753.098
EXPN	2	0.001	0.029	-1722.658	-1715.671
NLEX	2	0.001	0.029	-1722.659	-1715.673
EPRB	3	0.181	0.026	-1768.971	-1758.491
NLEP	3	0.181	0.026	-1768.972	-1758.493
ECUB	4	0.181	0.026	-1767.025	-1753.053
NLEC	4	0.181	0.026	-1767.025	-1753.053
GMTC	2	0.027	0.028	-1729.147	-1722.161
NLGM	2	0.027	0.028	-1729.148	-1722.162
HYPR	2	0.018	0.028	-1726.905	-1719.919
NLHP	2	0.018	0.028	-1726.909	-1719.923
MEXP	NE	–	–	–	–
NLME	NE	–	–	–	–
GOMP	NE	–	–	–	–
NLGP	NE	–	–	–	–
LGST	NE	–	–	–	–
NLLG	NE	–	–	–	–

NE: Non-Estimable

From amongst the estimable functional forms, PRBL equation has been observed to be associated with the minimum value (= -1769.019) of AIC and therefore, accepted as the *equation of the best-fit*. The estimated equation could be expressed as $\hat{Y} = b_0 + b_1 t + b_2 t^2$, where b_0 refers to the intercept term, while b_1 and b_2 denote the first-degree and second-degree effects of time variable 't' respectively on exchange rate of the Chinese Yuan (Y). The requisite computations in respect of this equation have been portrayed in Table-4.

Here, the intercept term (b_0) was highly significant, thereby implying that the best-fit function intersected with the Y-axis at a point 7.81 which was significantly away from the origin. Further, each of the coefficients b_1 and b_2 wasobserved to be statistically highly significant (at 1% level of significance.

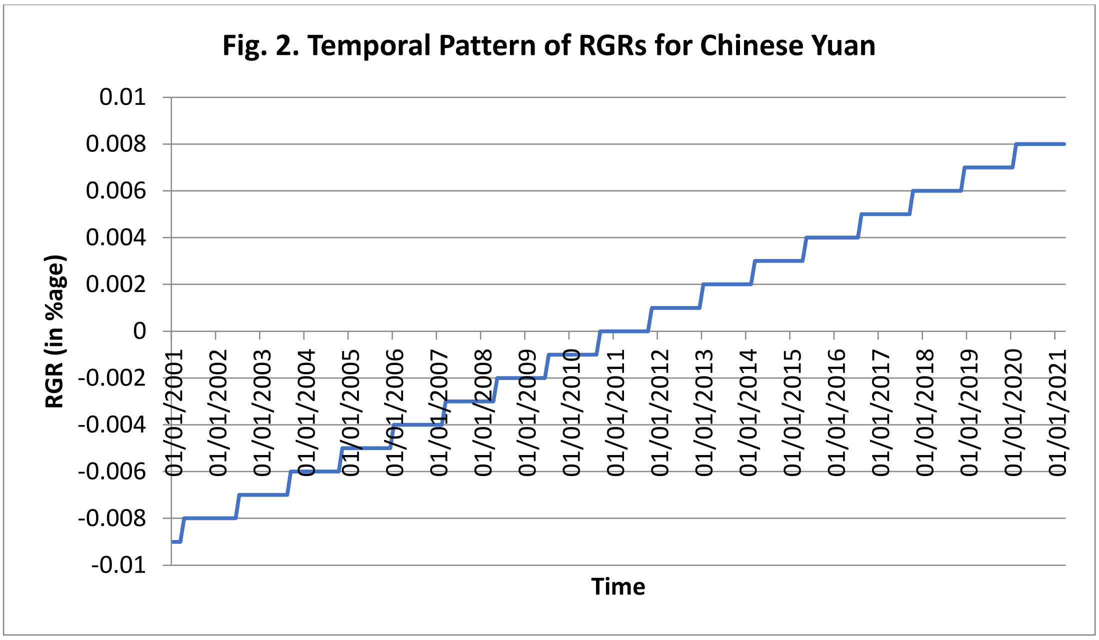
Table-4. Computations for Best-Fit Equation-- China

Parameters	Estimate	S.E. of Estimate	t-value	Prob.	Sig.
b_0	7.81E+00	5.06E-03	1542.266	< 0.0001	*
b_1	-6.85E-04	9.58E-05	-7.144	< 0.0001	*
b_2	2.77E-06	3.80E-07	7.27	< 0.0001	*

R^2 = 0.1809*; Adj R^2 = 0.1741; p = < 0.0001; AIC = -1769.019
*: Significant at 1% level.

Thus, it was the linear as well as the curvilinear effect of time 't' which influenced the exchange rate of the Chinese Yuan. For the best-fit equation, the value of R^2 was computed to be 0.1809 meaning, thereby, that time variable 't' was responsible for creating only 18.09 percent of the variation in the exchange rate of the Chinese Yuan. Although the value appeared to be fairly low, yet the same was tested (through the usual F-test) to be highly significant ($p < 0.0001$), owing to sufficiently large number of the degrees of freedom (= 240) associated with the value of R^2. Adjusted coefficient of multiple determination (adj. R^2) was computed to be still lower at 0.1741. The low value of R^2 of Chinese Yuan vis-a-vis USD may be due to the fact that China having conflicts with US and has opted for not using US dollars and even relieving USD debt recently. Hence, Chinese currency has been observed as relatively independent of variations that could have observed due to Chinese integration with US.

The temporal pattern of the relative growth rates (as computed from the estimated coefficients b_0, b_1 and b_2 of the best-fit equation) in the exchange rate of the Chinese Yuan has been portrayed in Figure-2. As can be seen from the figure, the relative growth rates have increased successively (from -0.009 to 0.008 percent) in a step-manner without any perceptible turning point. The reason being the independence of Chinese Yuan vis-a-via USD.



IV. Conclusion

The study focussed on examining the temporal behaviour of the currencies of India and China viz., Rupee and Yuan vis-a-vis US Dollar. For both of these economies, monthly time series data from January, 2001 through March, 2021 were considered on national currency per USD from different secondary sources.Relative positioning of the currencies of the both the countries has been analyses through somewhat *non-traditional approach* (Sethi, 2008, 2010). In other words, each of the currency has been subjected to the estimation of *nineteen* alternative functional forms. From amongst the estimable equations, choice of the best-fit equation was made on the basis of Akaike's Information Criterion (AIC); the functional form associated with the minimum value of AIC was accepted to be the best-fit equation for the given currency. The analysis exhibited that equations Cubic (CUBC) and Parabolic (PRBL) were accepted to be the *equations of the best-fit* for Indian Rupee and Chinese Yuan, respectively. Considering the coefficients of so-chosen best-fit equation (EBF), values of relative growth rates (RGR_t) were obtained through certain formulas. Further, for each of the currencies, the computed values of RGR_t were plotted against time to locate *turning points*, if any, so as to identify changes in their temporal behaviour or we can say that to examine the nature of growth in the currencies.

The findings demonstrated that for the best-fit equation of Indian Rupee, the value of R^2 was computed to be as high as 0.9335 which was statistically highly significant meaning, thereby, that time variable 't' was responsible for creating nearly 93.35 percent of the variation in the exchange rate of Indian Rupee. Further, on the basis of the computed values of the unknowns of the best-fit equation (CUBC), values of relative growth rates in exchange rate of Indian Rupee were plotted at different points in time and the figure is a clear indicative of a parabolic pattern in the relative growth rates. A turning point was observed to have occurred in the beginning of the year 2013. Up to that point, the rates of growth kept rising (at diminishing rates) and started falling down subsequently (at increasing rates). It implies the vulnerability of Indian Rupee in response to fluctuations in USD. It can be said that this turning point of Indian Rupee in 2013 marks the severe depreciation since Indian Rupee was traded in the range of 45 to 50 from 2000-2010 and even it remained within a range of 54 to 57 from 2011 to 2013 but all of sudden Indian Rupee vis-a-via USD elevated these earlier ranges and instantly took a turning point with a value of 61.80 Rupee per USD.

Similarly, for Chinese Yuan exchange rate, the best-fit path has been detected to be Parabolic (PRBL). For this best-fit equation, the value of R^2 was computed to be 0.1809 meaning, thereby, that time variable 't' was responsible for creating only 18.09 percent of the variation in the exchange rate of the Chinese Yuan. The low value of R^2 of Chinese Yuan vis-a-vis USD may be due to the fact that China having conflicts with US and has opted for not using US dollars and even relieving USD debt recently. Hence, Chinese currency has been observed as relatively independent of variations that could have observed due to Chinese integration with US. Further, the temporal pattern of the relative growth rates as computed from the estimated coefficients of the best-fit equation (PRBL) in the exchange rate of the Chinese Yuan revealed that the relative growth rates have increased successively (from -0.009 to 0.008 percent) in a step-manner without any perceptible turning point. The reason being the independence of Chinese Yuan vis-a-via USD. The analysis has, thus, revealed that the values of exchange rates of both the currencies under consideration have behaved differently in terms of their best-fit behavioural paths as well as the temporal pattern of relative growth rates. Notably, Indian Rupee is more sensitive to USD in comparison to Chinese Yuan.

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