Misalignment between Foreign Exchange Rate and Fundamental Variables: A Comparative Study of India, China and USA

DISSERTATION

Submitted to
Babasaheb Bhimrao Ambedkar University
(A Central University)
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DECLARATION

I hereby, declare that this Dissertation entitled **"Misalignment between Foreign Exchange Rate and Fundamental Variables: A Comparative Study of India, China and USA"** submitted to Babasaheb Bhimrao Ambedkar University in partial fulfillment for the award of Master of Philosophy in Economics is my original work. It has not been submitted in part or full for any other diploma or degree of any other University. The indebtedness of the candidate to others has been duly acknowledged at relevant places.

This study is carried out under the supervision of **Dr. D. K. Yadav**, Assistant Professor in Department of Economics, Babasaheb Bhimrao Ambedkar University Lucknow.

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CERTIFICATE

This is to certify that the Dissertation entitled **"Misalignment between Foreign Exchange Rate and Fundamental Variables: A Comparative Study of India, China and USA"** submitted by **Saleha Jameel Ansari** is an original research work and has not been previously submitted in part or full for the award of any other degree or diploma to this or any other university.

The dissertation submitted to Babasaheb Bhimrao Ambedkar University, Lucknow satisfies all the requirements as stipulated in the Master of Philosophy (M.Phil.) Regulations amended in 2017 incorporating the provision of the University Grants Commission Regulations, 2016 and it is fit for submission and evaluation for the award of the degree of Master of Philosophy in Economics of the University.

Date: 30/12/2019

Place: Lucknow

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1.1 Introduction:

The word globalization means free trade or free movement of goods and services all over the world in a integrated manner. Nowadays as economies are getting more integrated with the world economy and indulging more into extensive trade and capital flows with countries all over the world due to globalisation. Foreign exchange rate plays a important role as it determines the competitiveness of goods and services in the global markets, and affect the currency value. In 1973 exchange rates became much volatile after the collapse of Bretton Wood system. Due to exchange rate volatility lot many researches has been undertaken to understand the behaviour of exchange rate movements. The exchange rate is the price of domestic currency relative to foreign currency. As exchange rate determines the competitiveness of goods and services, the exchange rate has a direct impact on international prices of goods and services as well as financial assets, the value of currencies in terms of foreign currencies are essential in determining exports and imports of countries and the exchange of financial assets in global market according to various researchers, economists etc. The determinants of exchange rate are classified as short run and long run. Long run factor are linked with goods market and labour market whereas short run factors works through the changes in domestic and international financial markets. Inflation rate differentials, differences in domestic interest rate and foreign interest rate or expected future exchange rates all have an impact on current exchange rate in the short run. As inflation drops down domestic interest rate rises or foreign interest rate falls, they all lead to increased demand for the domestic currency; consequently the currency value increases or appreciates. Conversely as the demand for currency decreases in a domestic or global financial market, the currency value will lose its value relative to other currency. The long run factors determining exchange rate are trade policies, differences in price levels of products in domestic versus foreign countries, differences in productivity and preferences for foreign versus domestic products.

1.2 Definition of Exchange rate Misalignment:

When exchange rates do not follow the fundamental variables of a country, it is called exchange rates misalignment. Exchange rate misalignment can be harmful for the

growth of an economy, and if it persists, it may result in macroeconomic imbalances that may lead to macroeconomic crises and especially when it is beyond certain threshold value. The Exchange rate forecast plays a important role for policy maker to determine the output and inflation in the economy. As markets are globalised nowadays exchange rate misalignments are pretty much focussed in recent years.

As there are determinants of exchange rate various researches have been done on the deterioration of exchange rate misalignment. Going through various research papers few determinants of exchange rate misalignment are stated as under:

- The degree of freedom or openness.
- The nature of global specialization.
- The exchange rate regime along with the degree of financial liberalization.

The global financial crisis shone a spotlight on the US dollar as a pivot in international finance as it gave rise to a dollar shortage in 2008 more acute than that of the 1950s. The US authorities relieved the dollar shortage by entering into dollar swaps with central banks on an unprecedentedly broad scale and, with major central banks, in unlimited amounts (CGFS 2010). Before long, market concerns switched to possible excess dollar liquidity as the US Federal Reserve carried out repeated programs of large-scale bond purchases. The temporary dollar shortage and the subsequent worries over a dollar glut served to highlight the dependence of the international financial system on a currency subject to national management. In particular, the crisis put at risk international trade between countries outside the United States as banks in either country had difficulty rolling over dollar liabilities in the interbank market in order to finance their trade. More recently, economies outside the United States have tried to build dams to divert dollar inflows away. To a system engineer, it might appear to be a negligent design that left such a ‘single point of failure’ in the international financial system. Against this backdrop, a number of recent policy initiatives suggest that the Chinese authorities have adopted a proactive strategy to promote the international use of the Renminbi (RMB). Because the case of China is a very interesting example of understanding the power of the exchange rate in determining trade and growth trends of countries, the focus is on this country. Since the United States is the largest trading partner of China, it is the most affected country by China’s misaligned currency. Different actions are taken in the U.S. to smooth

these negative effects. For example, there have been numerous calls by the international community led by Mr. Charles Schumer; a Democratic senator from New York, who has been active in searching for new congressional actions against China's perceived undervalued currency and trade policies since 2004. [1]

Due to globalization exchange rate misalignments are pretty much focused and started to attract more attention in recent years. Recently India, China and USA are best examples of currency misalignment. In these countries exchange rates are not following the fundamental variables. Though China is doing well on global grounds then too its currency is devaluating since 1990s. This study investigates the misalignment between foreign exchange rate and the fundamental variables of India, china, and USA. This is the introductory chapter of the study so we will mention the research gap, scope of the study, objective of the study, Hypothesis and methodology, and the chapterisation of the study.

1.3 Review of Literature:

After the pioneering work of Balassa (1964) and Samuelson (1964) research on real exchange rate and currency misalignment proceeded in two related, but in distinct direction. The first is to measure currency valuation that is to estimate an "equilibrium" level of real exchange rate. The second is to apply currency valuation estimates to models explaining economic growth and specifically to estimate the deviation of economic growth from the equilibrium RER which is called misalignment or over and under valuation of the currency.

Bhalla (2002) found changes in the real exchange rate to be significant explanatory variable for growth acceleration – the greater the change in real exchange rate, the higher the acceleration in the per capita growth rates. The Balassa Samuelson thesis — that real exchange rate increases with per capita income – was confirmed for a number of countries, especially developed economies including Japan. So it is a belief that exchange rate increases with the acceleration of macro variables.

Charles Engel and Kenneth D. West (2005) argues that fundamental variables such as relative money supplies, outputs, inflation, and interest rates provide little help in predicting changes in floating exchange rates.

In the study of Nihal Bayraktar it is illustrated that when global economy came under real stress in 2008, Chinese economic growth dropped precipitously from 13 percent to 6 percent. But only after 12 months growth was back up by 12 percent. Other countries dropped by 30 percent where as in case of China it was just 15 percent in 2008-09 and the effect of the global downturn lasted only 12 months.

N R Bhanumurthy (2006) presents the study that investigates the relative importance of macro and micro variables in determining the exchange rate movements in India. In this study he works on primary data collected from the Indian foreign exchange dealers. In 2004 he presented the same issue worked with secondary data. N R Bhanumurthy illustrated in his study that fundamental variables are significant for long and medium run.

Parthapratim Pal and Partha Ray (2018) presents in their commentary that downfall of Indian rupee is due to global factors and huge dependency of oil imports. And the situation is not as bad as 2013. India's currency has indeed depreciated with respect of all four major currencies since April 2018.

As per the data of trading economics the inflation rate of India is lowest since 2014. GDP annual growth rate of India averaged 6.18 percent from 1951 until 2018 reach an all time high of 11.40 percent in the first quarter of 2010. Interest rate is averaged 6.66 percent from 2000 till 2018. So we can see from the above data that though India is performing well in terms of growth but its currency is depreciating since 1951. So the belief that exchange rate moves in the direction of macro variables is being violated.

Sophie Bereau, Antonio Lopez Villavicencio, Valerie Mighou (2009) in their study of currency misalignment and growth shows that the impact of exchange rate misalignment on economic growth depends upon the size and sign of the misalignment. They find that there exists positive relation between foreign exchange misalignment and economic growth when currency is undervalued whereas overvaluation negatively affects the economic growth.

Cecile Couharde, Andrey Sallenave (2013) in their journal found that undervalue currencies led to reversal of growth. They determine the threshold value of

misalignment. A level of 18.69 percent being benefit in terms of growth, beyond this effect is contractionary.

Martin Rapeti (2013) analysed the mechanism of currency misalignment. According to this study there are two mechanism of currency misalignment.

- Financial globalisation channel
- Tradable led growth channel

Both mechanism are not mutually exclusive, both might have some explanatory variables.

Geoffrey Garret (2011) presents the study in which he illustrated the US—Chinese economic relation after global financial crises. In that he depicted the position of US economy. Though US economy is not doing well in terms of growth still its currency is appreciating since long. Its employment rate is decreasing and its GDP growth rate is also decreasing. Inflation rate is also falling since long. On the other hand when we come to US Dollar index it is increased from 0.27 percent to 95.84 percent.

Adhiraj Arora et al. Attempted to understand the dynamics of Indian rupee fluctuations against US Dollar by using average quarterly observations over the period of 21 years. They also made an attempt to identify the key variables that influence exchange rate movements. After applying OLS and performing unit root and co integration tests, they observed that factors like differential interest rates, differential inflation rates, differential money supply in both the markets, differential output growth rates of both the countries, among others, are important factors that account for approximately 91 percent variance of the Dollar Rupee exchange rates and explain the exchange rates dynamics to a large extent. They also observed that after checking for auto correlation and applying FGLS, a few factors that were earlier considered to be important are not as significant as expected.

Jaroslav Mida aims to forecast the USD/EUR exchange rate using four macro economic variables, namely inflation, interest rate, unemployment rate and industrial production index. The model applied vector autoregressive model and he used monthly data for a period of 2002 to 2011 and used the data from 2012 in order to

compare the forecast accuracy with the random walk, which is believed to outperform many models when forecasting for a short time horizon, such as one year.

A paper of Jarko Jaskella and Mariano Kulish analyses some implications of indeterminacy of the rational expectations equilibrium for a small open economy. In the canonical sticky price small open economy model, he found that indeterminacy arising in the large economy can increase the volatility of the small economy. Their main findings, however, is that smallness is a property of the unique rational expectations equilibrium of the large economy, and not a general property of the small open economy model. If the large economy fails to anchor expectations, shocks to the small economy can affect large one. This form of indeterminacy gives rise to a "butterfly effect". They show that fundamental shocks to small economy can act like non fundamental shocks for the large economy.

1.4 Scope of study

Many researches have been done with currency misalignment, and these studies said exchange rate follows the growth rate but there is significant study that shows exchange rate is not following the fundamental variables. This study investigates the misalignment between foreign exchange rate and fundamental variables and it compares the data of three countries viz. India, China and USA where currency misalignment can be seen. Nowadays these three countries gained popularity due to its misalignments. This will be the first study that compares India, China and USA misalignments and considers misalignment between foreign exchange rate and fundamental variable as short run phenomenon.

1.5 Objectives of the Study

To study the pattern of movement of fundamental variables in case of India, China, and USA.

- In the context of movement of fundamental variables, to explore the variation in exchange rate of these countries.
- To study the pattern of misalignment between performance of fundamental variables and exchange rate determination.

1.6 Hypothesis

- Fundamental variables of India, China and USA have shown almost similar trend in the post reform period i.e. 1991.
- Variation in exchange rate of these countries follows the movement of fundamental variables.
- Misalignment between fundamental variables and exchange rate of these countries are short run phenomena and in the long run it corrects the misalignment in itself.

1.7 Methodology

In order to analyse the misalignment between foreign exchange and fundamental variables of India, China and USA secondary data will be used from the year 1991-2017. Various surveys, journals, books, and research articles will be used for the support of review. The method which will be used for assessing the impact of fundamental variables on exchange rate is trend analysis, basic statistical tool and linear regression models with dummy variable to mention the representative variable of fundamental variables and the pattern of misalignment between fundamental variables and exchange rate of these countries. For this analysis our base theory is Exchange rates in long run and short run.

1.7.1 Exchange Rates in Long Run and Short run

Like any other goods and services, exchange rates are also determined by the interaction of supply and demand.

Factors affecting exchange rate in long run

- Price level
- Preferences for Domestic versus Foreign Goods
- Productivity

Factors affecting exchange rate in short run

- Foreign interest rate
- Domestic interest rate

In this study the data from 1991 till 2017 is included and it is subdivided into two period viz. normal period and recessionary period. In these periods we will analyse the recession period and normal period and try to find out the differences in the behaviours of fundamental variable and foreign exchange rate in the recession and normal period. For normal condition value is 0 and recession period value is 1.

1.7.2 Sub period I

It includes four periods 1992-1996, 1999-2000, 2003-2006, and 2010-2017, all these periods are normal period. In sub period I all the normal periods are included and calculating the variations between foreign exchange and fundamental variables in the normal period respective to all the three economies.

1.7.3 Sub period II

It includes all the recessionary period i.e. 1991, 1997-1998, 2001-2002, and 2007-2009. In sub period II variations between foreign exchange rate and fundamental variables has been calculated through trend analysis.

Firstly I collected secondary data regarding the movement of fundamental variables in the post reform period of India, China and USA and then compare it with the help of trend analysis then try to analyze whether these countries accounted for similar patterns of movements in fundamental variables. Secondly I will analyse the variation (if any) in exchange rate with respect to movement of fundamental variable with the help of trend analysis and then finally find out the misalignment between performance of fundamental variables and exchange rate determination by using fixed effect LSDV model in order to prove the study empirically. I have used four models in order to the misalignment which are as under:

We base this empirical study on the pattern of misalignment in India, China and USA. The main question of this chapter is whether and how far exchange rate appreciates or depreciates change in fundamental variables of the respective country.

1.7.4 Variables

For our analysis we identify four independent variables as follows:

- Inflation rate
- Interest rate
- GDP growth
- Trade balance or current account balance

Here the dependent variable is SDR.

1.7.5 Data sources

We consider annual data for the four independent variables mentioned above for a period of 27 years (1991-2017). Also, data for the dependent variable is considered for the same period. We obtained the data from various sources like World Bank Development Index, IMF's e-library data etc.

1.7.6 Tests

Since the data we have is panel data, we first check the unit root problem in all the variables. The unit root tests will be used to check the stationarity of the data. For this, we apply Hadri LM unit root test on each variable to check whether each of these variables is stationary or not.

Hypothesis of Hadri LM test:

$H_{0:}$ All panels are stationary.

$H_{1:}$ Panel contains unit root

Now we use fixed effect LSDV model to be estimated as follows:

$$ER = f\,(GDP, Interest\ Rate, Inflation, CAB)$$

For tracing the currency misalignment with respect to GDP we define the model to be estimated as follows:

$$ER = \beta0 + \beta1GDP + \beta2D2 + \beta3D3 + B4GDPD2 + \beta5GDPD3 + ui \dots\dots(1)$$

Where

ER = Exchange Rate

β_0 = Intercept

β_1GDP = GDP of reference country {Reference country is India}

β_2D_2 = Dummy variable {Dichotomous; 1= China, 0= others}

β_3D_3 = Dummy variable {Dichotomous; 1= USA, 0= others}

β_4GDPD_2 = GDP of D_2

β_5GDPD_3 = GDP of D_3

For tracing the currency misalignment with respect to interest rate we use the model to be estimated as follows:

$$ER = \beta0 + \beta1Int + \beta2D2 + \beta3D3 + B4IntD2 + \beta5IntD3 + ui \dots\dots\dots(2)$$

Where

ER = Exchange Rate

β_0 = Intercept

β_1Int = Interest rate of reference country {Reference country is India}

β_2D_2 = Dummy variable {Dichotomous; 1= China, 0= others}

β_3D_3 = Dummy variable {Dichotomous; 1= USA, 0= others}

β_4IntD_2 = Interest rate of D_2

$\beta_5 IntD_3$ = Interest rate D_3

For tracing the currency misalignment with respect to inflation we use the model to be estimated as follows:

$$ER = \beta 0 + \beta 1 Inf + \beta 2 D2 + \beta 3 D3 + B4 Inf D2 + \beta 5 Inf D3 + ui \dots\dots\dots (3)$$

Where

ER = Exchange Rate

β_0 = Intercept

$\beta_1 Inf$ = Inflation in reference country {Reference country is India}

$\beta_2 D_2$ = Dummy variable {Dichotomous; 1= China, 0= others}

$\beta_3 D_3$ = Dummy variable {Dichotomous; 1= USA, 0= others}

$\beta_4 InfD_2$ = Inflation in D_2

$\beta_5 InfD_3$ = Inflation in D_3

For tracing the currency misalignment with respect to current account balance we use the model to be estimated as follows:

$$ER = \beta 0 + \beta 1 Cab + \beta 2 D2 + \beta 3 D3 + B4 Cab D2 + \beta 5 Cab D3 + ui \dots\dots\dots (4)$$

Where

ER = Exchange Rate

β_0 = Intercept

$\beta_1 cab$ = Current account balance of reference country {Reference country is India}

$\beta_2 D_2$ = Dummy variable {Dichotomous; 1= China, 0= others}

$\beta_3 D_3$ = Dummy variable {Dichotomous; 1= USA, 0= others}

$\beta_4 cabD_2$ = Current account balance of D_2

$\beta_5 cabD_3$ = Current account balance D_3

Basically there are three chapters, two core chapters and a main chapter, in the first core chapter pattern of movement of fundamental variables of the three economies has been analysed. In the second core chapter variations in exchange rate with respect to the movement of fundamental variable of India, China and USA has been analysed through trend analysis and descriptive statistical tools. In the final and main chapter i have used four models to interpret the result of the analysis regarding pattern of misalignment between foreign exchange and fundamental variables of the respective countries.

1.8 Chapter Plan

This study is organised in six chapters which is as under:

- Introduction
- Conceptual And Theoretical review.
- Pattern of movement of fundamental variables in the post reform period: A comparative analysis of India, China, and USA.
- Analysis of variation in exchange rate with respect to movement of fundamental variables.
- Pattern of misalignment between performance of fundamental variables and exchange rate determination.
- Conclusion and policy prescription.

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2.1 Introduction

Before diving into empirical and analytical discussion it is important to situate the argument within conceptual and theoretical framework. Here I am going to present the study of misalignment between foreign exchange rate and fundamental variables of growth in India, China and USA. I will examine various concepts related to foreign exchange rate and fundamental variable of growth and the theories related to foreign exchange rate as my study revolves around the foreign exchange. Firstly I will go through various concepts of fundamental variables of growth (such as GDP, Interest rate, Inflation, Current Account Balance) and then I will focus on the concepts of foreign exchange rate (i.e., Terminology of foreign exchange rate, undervaluation and overvaluation of currency, transactions of foreign exchange rate etc.). Then I will move towards the analysis of previous theories related to foreign exchange rate determination. This chapter is divided into two sections. The first part constitutes the whole concepts going to be used in my study. This section is further subdivided in two parts. Part one consists of all the concepts related to fundamental variables and part two consists of concepts regarding foreign exchange and currency. The second part constitutes various theories of determination of foreign exchange.

2.2 Concepts regarding Fundamental Variables

Before explaining anything the first question arises what is growth and how is it calculated? So the answer is economic growth is an increase or decrease in economic variables over a period of time. The most important aspect of growth is its quantitative measurement and it is a quantitative progress so it can be negative or positive. Economic growth is a very wide term in economics which is useful at national level economic analysis and policy making as well as it is highly useful in comparative analysis of economies. There are various variables that define economic growth which are explained briefly below.

2.2.1 Gross Domestic Product (GDP)

It is first and foremost thing that comes to our mind while talking about economic growth. GDP is the value of all final goods and services produced within the domestic

boundary of a nation during a particular period of time. It is calculated by adding national consumption, gross investment, government spending and trade balance. It is one of the utmost important scales of measurement in economic growth.

Real GDP Vs Nominal GDP

We can measure the GDP for a particular year using actual market prices of that year called as nominal GDP or GDP at current prices. But real GDP is calculated by tracking the volume or quantity of production after removing the influence of changing price level or inflation; so real GDP represents the change in volume of total output after prices are removed and nominal GDP is calculated by using changing price. The price of GDP is the difference between real and nominal GDP which is called GDP deflator.

$$GDP\ deflator\ =\ nominal\ GDP\ /\ real\ GDP$$

2.2.2 Rate of Interest

It is the price for the use of savings, is determined by savings and investment. If savings is more than investment, rate of interest falls on the other hand if investment is more than savings, rate of interest rise. If rate of interest is low investment will increase, similarly if rate of interest is high investment will fall. In this way balance between savings and investment is maintained through rate of interest. [3]

Real interest rate vs. Nominal interest

Nominal interest rate is that interest which is provided by a bank to its depositors on the savings account or fixed deposits of different maturity period. It is also agreed nominal rate at which the lenders lend the money to the borrowers. On the hand when we talk of real interest rate, it means how fast the purchasing power of your deposit in the bank increases over a year. The purchasing powers of the money not only depend upon nominal rate but also inflation rate that takes place over time. Thus real rate of interest can be obtained from nominal interest rate by adjusting for inflation rate that takes place in a year. [3]

$$REAL\ INTEREST\ RATE\ =\ NOMINAL\ INTEREST\ RATE - INFLATION\ RATE$$

$$r\ =\ i - \pi$$

Here,

r = real interest rate,

i = nominal interest rate,

And π = inflation rate. [3]

2.2.3 Inflation

According to economists the term inflation is used to denote an ongoing rise in the general price level quoted in units of money. Inflation rate is the annualized percentage growth of money prices. The inflation means a fall in the overall purchasing power of the monetary unit. In this phenomenon there is a continuous increase in the price level not a onetime jump.

Causes of inflation

1) Demand pull inflation: The imbalances of aggregate demand and aggregate supply results in rise of price level, when aggregate demand is relatively more than aggregate supply.

2) Cost push inflation: It may happen when there is an initial increase in costs independent of any increase in aggregate demand. The four main increases in costs which generate cost push inflation a) Oil price shocks b) Farm price shock c) Import price shock d) Wage push inflation. Cost push inflation increases the general price level as well as it also decreases GDP level.

3) Structural Inflation: Structural inflation is due to the structural feature of the economy. Structural inflation is prevailing in all developing countries.

2.2.4 Balance of Payment

In the era of globalization, there is hardly any country which is not involved in trade of goods and services all over the world. Almost every country imports from other

countries the goods that cannot be produced at all in the country or can be produced only at high industrial cost comparative to the foreign supplies. Similarly, a country exports to other countries the products that those countries wanted to buy from abroad." The balance of payment is a systematic record of economic transactions of the residents of a country with the rest of the world during a given period of time". The record is so prepared as to provide measure to the various components of a country's external economic transactions. Thus the aim is to present an account of all receipts and payments on account of goods exported, services rendered and capital received by residents of a country and goods imported, services received and capital transferred by residents of the country. It makes us know the international economic position of the country and to help government in reaching on monetary and fiscal policies and trade and payments of the country. It is one of the indicators of the economic growth of the country globally.

Deficit and surplus of balance of payment

If the value of exports exceeds the value of imports the country is said to experience an export surplus or a favorable balance of trade. If the value of its import exceeds the value of its exports, the country is said to have deficit or an unfavorable balance of trade. Both surplus and deficit need to be checked for economic growth.

The above paragraphs constitute the concepts of fundamental variables of economic growth which will help to understand these variables. Now I am moving towards the concepts of foreign exchange as all these concepts will clarify my study. First and foremost question arises what is foreign exchange? Answer is when all countries are indulged into foreign trade and foreign trade involves use of different currencies. The foreign exchange rate is determined in the foreign exchange market where currencies are in trade. We measure foreign exchange rate as the amount of foreign currency that can be bought with one unit of domestic currency.

2.3 Concepts Regarding Foreign Exchange

2.3.1 Terminology of Foreign Exchange Rate

Foreign exchange uses a set of special vocabulary for currency value. According to the definition, when price of a currency drops in terms of another currency is called

depreciation on the contrary an increase in the price of a currency in terms of other currency is known as appreciation. These two terms are market driven. A different set of terms is used when foreign exchange market intervened by the government. The term is known as devaluation, if a country lowers the official price of its currency in the market. When the official foreign exchange rate is raised it is termed as revaluation. It is done deliberately by the government.

2.3.2 The Exchange Rate Regime

The term denotes the institutions under which payments are made for transaction that cross national boundaries. In particular international monetary system determines how foreign exchange rate are set and how government can affect exchange rate. The central element of the international monetary system involves arrangements by which exchange rates are set. Currently, countries have used one of the three exchange rate regime. Exchange rate regime is simply the method by which a country manages its currency.

- A system of fixed exchange rate.
- A system of flexible or floating exchange rate.
- Managed exchange rate.

2.3.2.1 Fixed Exchange rate regime (The Gold Standard)

Fixed exchange rate regime is one of the oldest and most significant exchange rate systems. It is also known as gold standard, which was used from 1717 to 1936. In this system each defined the values of its currency in terms of fixed amount of gold, thereby establishing fixed exchange rates among the countries on the gold standard. Gold would be the common world currency. Once gold became the medium of exchange of money, foreign trade would become same as domestic trade. The exchange rate under gold standard is also known as par value or parities. Sometimes a currency is fixed against a basket of currencies; but this is less purely fixed as it implies substantial variability in exchange rate relative to individual currencies. In addition if the composition of the basket is not announced publicly. The government can alter the exchange rate by altering the basket.

For much of the late nineteenth and early twentieth century the US was hotbed of exchange rate controversies. A succession of US movements for international monetary alternative – Paper currency (greenbacks); a silver standard, bimetallism and variety of related schemes – were the global focal point of opposition to the gold standard. Many are against the gold standard and at the same time many supports the gold standard.

Dr. B R Ambedkar also gave his view points in favor of gold standard. Ambedkar's London doctoral thesis was on the management of rupee. At that time there was a big debate on the relative merits of gold standard. He argued in favor of a gold standard as opposed to the suggestions by J M Keynes that India should embrace a gold exchange standard. He said that a gold exchange standard allowed the issuer a greater freedom to manipulate the supply of money, jeopardizing the stability of the monetary unit.

2.3.2.2 Flexible Exchange Rate Regime

Under the flexible exchange rate or floating exchange rate system exchange rates are freely determined in an open market primarily by private dealings and like other market prices vary from day to day. Under the flexible exchange rate system, the first impact of any tendency towards a surplus/deficit in the balance of payment or the exchange rate. A surplus in the balance of payment (BOP) will create excess demand for the currency and the exchange rates will tend to rise and similarly, a deficit in the BOP will rise to an excess supply of the currency and the exchange rate will hence tend to fall.

2.3.2.3 Managed Exchange Rate Regime

It is also known as 'hybrid system' there is some other hybrid system along with managed exchange rate system which is discussed below. Under this system, a country will buy or sell its currency to reduce the day to day volatility of currency fluctuation. In addition, a country will sometimes engage in systematic intervention to move its currency toward what it believes to be more appropriate level. For example Japan and many other developing countries.

2.3.2.4 Pegged Exchange Rate Regime

A few small countries peg their currencies for a major currency or to a basket of currencies in a fixed exchange rate. The peg is allowed to glide smoothly upward or downward in a system known as gliding or crawling peg. A few countries have the hard fix of a currency board and others set their currencies equal to dollar known as dollarization. This is also one of the hybrid systems of exchange rate regime.

In addition, almost all countries tend to intervene both when market become "disorderly" or when exchange rate seems out of line with the "fundamentals" – that is when they are highly inappropriate for existing price levels and trade flows.

2.3.3 Level of Exchange

Monetary authorities make policies that influence the level of exchange rate – the currency's value. A currency can rise in value – appreciate or revalue – in relation to other currencies or decline in value – depreciate or devalue. Exchange rate can move differently against different currencies. The best summary measure is the effective exchange rate, a country's exchange rate against other currencies weighted by their importance in the country's trade. Movements in the nominal exchange rate simply measures the relative value of the currency, are often less meaningful than changes in the real exchange rate, which adjusts for inflation differentials between countries. If the home country has 20 percent inflation with exchange rate held constant this is the equivalent of a real depreciation of the home country's currency. It is also equivalent to a real appreciation of the foreign currency, as prices of its goods expressed in its own currency have risen relative to those of the home country.

The real exchange rate reflects the impact of the exchange rate on country's trade and payments. The real value of the currency is crucial to every open economy because it affects the prices of national goods. Currency values have a powerful impact on the well being of important economic actors and indeed, the fate of national economies more broadly.

$$RER = e.\ p/p^*$$

Here, RER is real exchange rate, e is nominal rate of exchange, p is price in domestic currency, p* is price in foreign currency. [7]

2.3.4 Transaction of Foreign Exchange Market

There are certain important types of transaction conducted in the foreign exchange market which are as under:

2.3.4.1 Spot Market

In the spot market foreign exchange are completely on the spot immediately. It requires immediate delivery or exchange of currencies on the spot. The rate of exchange effective for the spot transaction is known as the spot rate and the market for such transaction is called as the spot market.[3]

2.3.4.2 Forward Market

In a forward market forward contracts are delivered at a specified future date. The rate of exchange applicable to the forward contract is known as forward exchange rate and its market is called forward market. It is quite beneficial for the exporter as well as importers as they can cover the risks arising out of exchange rate fluctuation by entering into an appropriate foreign exchange contract.[3]

There is a relationship between forward and spot market, with reference to it the forward rate may be at par discount and premium. When demand is equal to the supply the forward market tend to be at par. In other words when forward market is exactly equal to the spot rate at the time of contract the forward exchange rate is said to be at par. The premium is usually expressed as a percentage deviation from the spot rate on a per annum basis. When the demand for forward exchange exceeds its supply, the forward rate will be quoted at a premium. The discount is also usually expressed as a percentage deviation from spot rate on a per annum basis but when the supply of forward exchange exceeds the demand for it the rate is quoted at discount.

2.3.4.3 Futures

Future contracts are similar to forward but there are several differences between them. Future contracts have standard features while a forward contract may be customized. A future contract has standard size and maturity date. It can be traded only in organized market.

2.3.4.4 Options

Options combine advantages of futures and spot. It is a contract that gives holder the right, but not the obligation to sell/buy a given quantity of an asset at a specified price and future date. An option to buy the underlying asset is known as call option and an option to sell underlying asset is known as put option. Buying/selling the underlying asset via option is known as exercising the option. The state price paid/received is known as the exercise or striking price. The buyer is known as long and the seller called to be writer. There are two types of options, first European option that can be exercised only at maturity. Second is American option, it can be exercised at any time during the contract.

2.3.4.5 Swap Operation

Commercial banks who conduct forward exchange business may resort to a swap operation to adjust their fund position. The term swap means simultaneous sale (purchase) of spot currency for the forward purchase (sale) of the same currency. The spot is swapped against forward. Technically this operation is known as swap or double deals.

2.3.4.6 Arbitrage

Arbitrage tends to equalize exchange rate across the world. It is simultaneous buying and selling of foreign currencies with the intention of making profits from the differences in the exchange rate prevailing at the same time in different market.

2.4 Concepts Related to Currency

There are some concepts related to currency which will make my study more understandable. These are as under:

2.4.1 Currency Manipulation

According to the rules of International Monetary Fund currency manipulation means "A member will only be considered to be manipulating exchange rates in order to gain an unfair competitive advantage over other members if the fund determines both that: (A) the member is engaged in these policies for the purpose of securing fundamental exchange rate misalignment in the form of an undervalued exchange rate and (B) the purpose of securing such misalignment is to increase net exports." [9]

2.4.2 Currency Misalignment

If a country runs persistent, and trade surpluses or deficits exist, its currency is said to be misaligned. As per my study currency misalignment is, whenever Foreign exchange rate do not follow the fundamental variables then the currency is misaligned.

2.5 Theoretical Review

Now I will examine the theories accumulated in regard to foreign exchange rate. It will help us to establish what theories already exist for the determination of the par values of different currencies alternative. Mainly there are two important theories to explain the mechanism of foreign exchange rate determination i.e. the purchasing power parity and BOP/demand and supply theory. But there are others too so, some of the prominent theories are given as under:

2.5.1 Mint Parity Theory

The oldest and known theory of foreign exchange has been the mint parity theory. It was applicable to the countries where same metallic standard (gold/silver) had been used. In the gold standard countries had their standard currency unit either of gold it was freely convertible into gold of a specified purity. The value of currency unit under gold standard was defined in terms of weight of gold of a given purity contained in it. The central bank of the country was always willing to buy and sell gold up to a limitless extent at the specified price. The price at which the standard currency unit of the country was convertible into gold was called as mint price. For example: If the price of gold in Britain was 20 pound/ounce and in the US it was 80

dollar/ounce these were the mint prices of gold in the two countries. The rate of exchange between these two currencies would be determined as 20 pounds = 80 dollars i.e. 1 pound = 4 dollars. It is determined on weight to weight basis of the metallic contents of currencies of the two countries was called mint par of exchange or the mint parity. So the mint par values of the two currencies determined the basic rate of exchange between them.

In the gold standard the BOP adjustments were made through the free international flows of gold. As a result the actual rate of exchange between two currencies could vary above and below the mint parity by the extent of cost of gold export. There are two terms first upper specie point and second lower specie point. These points define the limit within which the fluctuation can take place in the market rate of exchange.

The mint parity theory was severely criticized on the various grounds. The international gold standard was completely abandoned. It is therefore unrealistic to analyze the rate of exchange. It is practically insignificant in the determination of exchange rate. It is not more than an academic exercise in the modern times. [8]

2.5.2 Interest Rate Parity Theory

According to this theory the interest rate differential of two countries is equal to the differential of the forward exchange rate and the spot exchange rate. The interest rate parity plays an important role in foreign markets, connecting interest rate, spot exchange rate and foreign exchange rate.

When a country offers a higher risk free rate of return in one currency than that of another, the country that offers the higher risk free rate of return will be exchanged at a more expensive future price than the current spot price.

The formula of interest rate parity

$$F0 = S0 * (1 + id / 1 + if)$$

Where

F_0 = foreword rate

S_0 = spot rate

I_d = interest rate in country D

I_f = interest rate in country F

2.5.3 Purchasing Power Parity

The purchasing power parity theory was forwarded by Gustav Cassell in the years following the First World War at that time the exchange rates are free and the rate of exchange between two countries will be determined by their respective purchasing power in the long run. In the words of Cassell, "the rate of exchange between two currencies must stand essentially on the quotient of the internal purchasing power of their currencies".

Absolute and Relative Purchasing Power Parity:

The absolute PPP theory suggests that a product which is easily and freely traded in a perfectly competitive global market should have the same price everywhere, once the price at different places are expressed in the same currency. The law of one price proposes that the price (P) of the product in domestic currency will be equal to the price (pf) of the product in the foreign currency through the current spot exchange rate (e).

$$P = e.pf$$

Relative PPP defined as that percentage change in the bilateral exchange rate is equal to the difference in the percentage change in the national price level in the given time period. The absolute PPP is a statement about absolute prices and exchange rate levels, whereas the relative PPP is a statement about absolute price and exchange rate changes over time. The rate of exchange tends to set at that point where the respective purchasing power of the two currencies are equal. The point is called the purchasing power parity.

Although the PPP theory has very many merits but it has a number of limitations too. On various grounds the PPP theory has been criticized by number of economists.

2.5.4 Exchange Rates in Long Run and Short run

Like any other goods and services, exchange rates are also determined by the interaction of supply and demand.

Factors affecting exchange rate in long run

- Price level: In the long run, an increase in a country's price level relative to the foreign price level causes currency to lose its value, and a fall in the country's relative price level causes its currency to gain the value.

- Preferences for Domestic versus Foreign Goods: A rise in the demand for country's export causes its currency to appreciate; conversely, increased demand for imports causes the domestic currency to depreciate in the long run.

- Productivity: If a country becomes more productive relative to other countries, its currency appreciates in the long run.

Factors affecting exchange rate in short run

- Foreign interest rate: An increase in the foreign interest rate causes domestic currency to depreciate and vice versa.

- Domestic interest rate: A rise in domestic interest rate causes an appreciation in domestic currency and vice versa.

Table 2.1 Factors of Exchange Rate and its Affect on Currency Value

Factors	Change in Factors	Response of currency value
Domestic interest rate	↑	↑
Foreign interest rate	↑	↓
Expected domestic price level *	↑	↓
Expected import demand	↑	↓
Expected export demand	↑	↑
Expected productivity *	↑	↑

*Relative to other countries

Note: Only increases in the factors are shown; the effects of decreases in the variables on the exchange rate the opposite of those indicated in the "Response" column

Source: *The economics of money, banking, and financial market*, Mishkin, F. S.

2.5.5The Balance of Payment (Demand and Supply) Approach

The BOP theory or general equilibrium theory of exchange rate says that the exchange rate in free market conditions is determined by the conditions of demand and supply in the foreign exchange market. According to this theory the price of a currency i.e. the exchange rate determined just like the price of any product which is determined by the forces of demand and supply of the market.

The value of a currency increases when the demand rises, and decreases when the demand falls, in relation to its supply in the foreign exchange market. The extent of the demand for and supply of a currency in the foreign exchange market depend on its BOP position. When the supply of and demand for currency are equal, the BOP is in equilibrium. When a country is in deficit, supply of currency exceeds its demand and causes a fall in the external value of currency. Similarly when there is surplus demand exceeds supply and causes a rise in the external value of the currency. A rise in demand for foreign exchange results from demand for foreign goods, services, financial assets etc. and the supply of foreign exchange comes from the foreign demand for the home country's goods, services, financial assets etc. [8]

2.5.6 Monetary Approach

The limitation of the PPP theory to explain real world exchange rate behavior gave rise to a set of monetary models which includes the possibility of capital/bond market arbitrage apart from goods market arbitrage assumed in the PPP theory. In monetary approach, the exchange rate is determined by the money supply in relation to money demand in both home and foreign country. The most important monetary models are:

2.5.6.1 Flexible price model

It is defined by Michael Mussa and Bilson. According to this model, high monetary growth rate in a country could result in high inflationary expectation trading to a reduction in the demand to hold real money balances and increase in expenditure on goods, consequently a rise in domestic price level and a depreciating currency in order to maintain PPP. Empirical tests of the flexible price model provided weak results.

2.5.6.2 Sticky price model

It is extended by Dornbusch in 1976. In this model, the goods and labor market are featured by sticky prices. It is particularly downward sticky. But exchange rate may immediately respond to new developments and shocks, therefore the exchange rate could not be matched by corresponding price movements and there could be persistent from PPP. When the real output is fixed, monetary expansion in short run would lower interest rate and cause the exchange rate to overshoot its long run depreciation.

2.5.6.3 Real interest differential model

The real interest rate differential model mixes the flexible price monetary model and sticky price model.

2.5.7 Portfolio Balance Approach

The portfolio balance model was forwarded to overcome the weaknesses of the monetary models. In portfolio balance model, the current account balance position finds the place in of exchange rate over time. A current account surplus implies an accumulation of foreign assets and the resultant larger proportion of foreign bond investors' portfolio than desired. Given the imperfect substitution between domestic and foreign bonds, it results in appreciation of the exchange rate. There is no strong empirical evidence to support it as an alternative to the monetary model. [1]

2.5.8 Chaos Theory and Foreign Exchange

Chaos theory was introduced and applied by Edward Lorenz in 1965 for the first time in meteorology. Nowadays this science is the milestone for fundamental changes in sciences especially meteorology, astrology, mechanics, physics, mathematics, biology, economics, statistic and management. Even though chaos theory in recent decades has been part of survey in miscellaneous scientific fields, but its basic concept has its root in primitive humans understanding of the universe. The Greek word of chaos that is translated to disorder and

Lawlessness shows ancient Greek understands of the universe. According to this view of point, although world's entities seem to be chaotic and random and as a result unpredictable, but at the same time they are in order and deterministic. [1]

The foreign exchange market is the largest and most liquid of the financial markets. Foreign exchange rates area amongst the most important economic indices in the international monetary markets. The forecasting of them poses many theoretical and experimental challenges. Although there are many researches and theories related to foreign exchange in terms of the ability to profit from the financial market but this theory try to recognize order and pattern governing them and use them for predictability future trend in short term. Nowadays this knowledge with the help of data behavior analysis has provided the base of structural changes in future.

The study shows existence of complex chaotic behavior in foreign exchange rate market in Iran. We can say data have big degree freedom in their behavior and shows random like behavior. [1]

2.5.9 Butterfly Effect

An interesting example is chaos theory, popularized by Lorenz's butterfly effect: "does the flap of a butterfly's wings in Brazil set off a tornado in Texas?" A tiny cause can generate big consequences!

A paper of Jarko Jaskella and Mariano Kulish analyses some Implications of indeterminacy of the rational expectations equilibrium for a small open economy. In the canonical sticky price small open economy model, he found that indeterminacy arising in the large economy can increase the volatility of the small economy. Their main findings, however, is that smallness is a property of the unique rational expectations equilibrium of the large economy, and not a general property of the small open economy model. If the large economy fails to anchor expectations, shocks to the small economy can affect large one. This form of indeterminacy gives rise to a "butterfly effect". They show that fundamental shocks to small economy can act like non fundamental shocks for the large economy. [2]

2.6 Conclusion

So above I present various concepts and terms related to fundamental variables of economic growth and foreign exchange. Then I present various theories related to foreign exchange rate determination which will help in analytical and empirical study of misalignment between foreign exchange rate and fundamental variables of economic growth.

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CHAPTER 3

PATTERN OF MOVEMENT OF FUNDAMENTAL VARIABLES IN POST REFORM PERIOD (1991-2017): A COMPARATIVE ANALYSIS OF INDIA CHINA AND USA

3.1 Introduction

Economic growth refers to an ability of an economy to increase its productive capacity through which it become more capable of producing additional units of goods and services. Economies all around are of great concern working on the new ways and techniques to promote the economic growth. The economic growth is also considered quite significant for economic policies; economy plans its economic policies accordingly. Macro variables play a very significant role in bringing economic growth to a country. It is said that major macro variables such as GDP, inflation, interest rate, balance of payment, employment rate are interrelated. Like high growth rate without increase in inflation is beneficial for an economy. Over a long period of time the low level of economic growth in developing countries causes great difficulty for the policy makers, professionals and government.

The objective of this chapter is to study the pattern of movement of fundamental variables in case of India, China, and USA. Through trend analysis and basic econometric tools we tried to analyze the pattern of movement in fundamental variables during normal and recessionary period from post reform period. The hypothesis of the chapter is whether the pattern of movement in fundamental variables of the three countries is similar or varied.

This chapter represents the pattern of movement of major macro variables that is GDP growth, inflation, interest rates, and current account balance of three countries viz. India, China and USA since post reform period and also compares the three in terms of their fundamental variables. Although many researches and papers helped in determining the growth pattern of macro variables but still it is difficult to predict behavior of movement in terms of economic growth. The economy is interrelated with politics, culture and institutions which make it sufficiently complex. Hence to understand economy's rapid growth one has to focus largely on its major macro variables that affect economic growth. So this chapter also emphasizes major macro variables of these countries in order to compare their economic growth. The comparisons are made through overall mean and variance. These comparisons are divided into two periods one is normal and another is recessionary period. Accordingly the chapter is divided into two sections, first section compares

fundamental variables of the three economies that is India, China and USA in normal period and the second section compares the three in recessionary period. According to IMF, there have been four global recessions since world war two, beginning in 1975, 1982, 1991 and 2009. The last recession was the deepest and widest of them all. The great recession was an extended period of extreme economic distress observed around the world between 2007 and 2009. The scale, impact, and recovery of the downturn varied from country to country. The recession of 1991 was mild relative to other post war recessions. According to UNDP, there were two more recessionary period one is 1997-1998 it was known as Asian financial crises and crises Ruble and the other is 2001-2002 it is called Dot.com bubble burst. As I am comparing the fundamental variables of the three countries since 1991 so according to my data there were four recessionary periods that is 1991, 1997-98, 2001-02 and 2007-09 and the last recessionary period persists longer that is between 2007-2009. So pattern of movement of fundamental variables will be observed on the basis of normal period and recessionary period country wise and then compare the economic growth of these three countries.

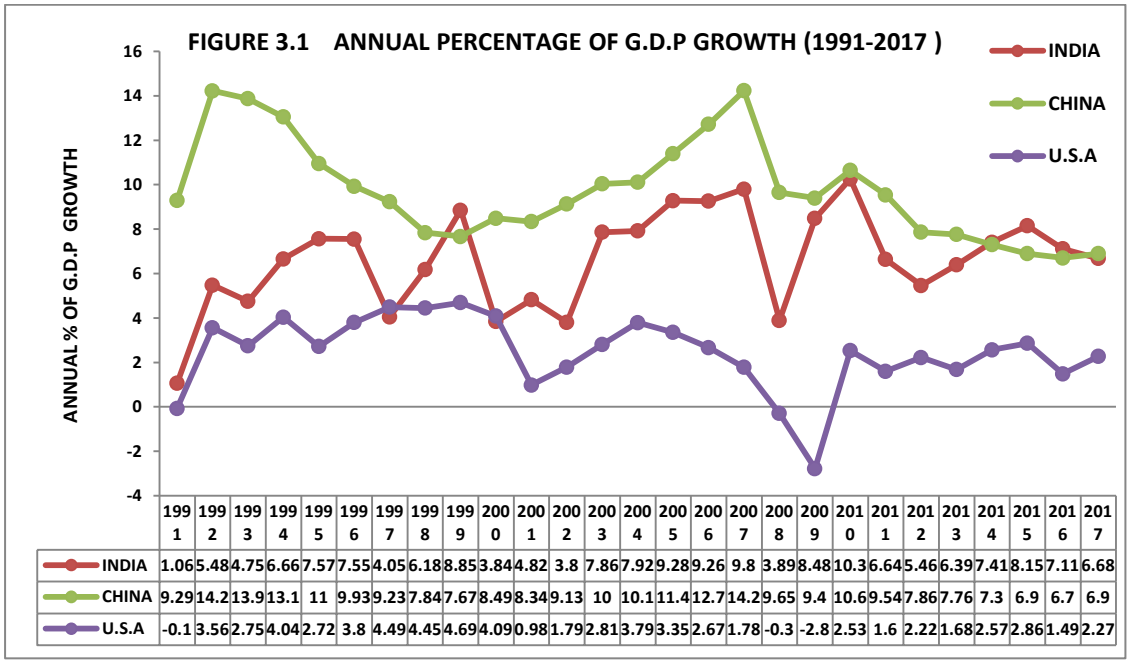
3.2 Pattern of movement of GDP Growth in India, China and USA

Table 3.1 Annual percent of GDP growth in India, China and USA (1991-2017)

Year	GDP growth of India	GDP growth of China	GDP growth of USA	Category of period
1991	1.06	9.29	-0.07	Recession
1992	5.48	14.22	3.56	Normal
1993	4.75	13.87	2.75	Normal
1994	6.66	13.05	4.04	Normal
1995	7.57	10.95	2.72	Normal
1996	7.55	9.93	3.8	Normal
1997	4.05	9.23	4.49	Recession
1998	6.18	7.84	4.45	Recession
1999	8.85	7.67	4.69	Normal
2000	3.84	8.49	4.09	Normal
2001	4.82	8.34	0.98	Recession
2002	3.8	9.13	1.79	Recession
2003	7.86	10.04	2.81	Normal
2004	7.92	10.11	3.79	Normal
2005	9.28	11.4	3.35	Normal
2006	9.26	12.72	2.67	Normal
2007	9.8	14.23	1.78	Recession
2008	3.89	9.65	-0.29	Recession

2009	8.48	9.4	-2.78	Recession
2010	10.26	10.64	2.53	Normal
2011	6.64	9.54	1.6	Normal
2012	5.46	7.86	2.22	Normal
2013	6.39	7.76	1.68	Normal
2014	7.41	7.3	2.57	Normal
2015	8.15	6.9	2.86	Normal
2016	7.11	6.7	1.49	Normal
2017	6.68	6.9	2.27	Normal

Source: World Development Indicators



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
INDIA	1.06	5.48	4.75	6.66	7.57	7.55	4.05	6.18	8.85	3.84	4.82	3.8	7.86	7.92	9.28	9.26	9.8	3.89	8.48	10.3	6.64	5.46	6.39	7.41	8.15	7.11	6.68
CHINA	9.29	14.2	13.9	13.1	11	9.93	9.23	7.84	7.67	8.49	8.34	9.13	10	10.1	11.4	12.7	14.2	9.65	9.4	10.6	9.54	7.86	7.76	7.3	6.9	6.7	6.9
U.S.A	-0.1	3.56	2.75	4.04	2.72	3.8	4.49	4.45	4.69	4.09	0.98	1.79	2.81	3.79	3.35	2.67	1.78	-0.3	-2.8	2.53	1.6	2.22	1.68	2.57	2.86	1.49	2.27

The above figure and table shows the trend of GDP growth of India, China and US from the post reform period that is from 1991 to 2017. In the diagram India is represented by the red line on the other hand blue line represents USA and green line shows the movement of Chinese economy. Initially in 1991 there was recession so the GDP growth of India and USA was very low, even USA showed a negative GDP growth. At the same time China maintained highest rate of GDP growth among the three i.e. 9.29 percent. Then in the very next period all the economies rose back and showed an exponential growth. In 1997 again recession hit India and China but USA maintained a stagnant growth in terms of GDP. In the year 1999 India's GDP rose to 8.85 percent and then in the very next year it fell down drastically. In 2001-2002 USA GDP growth fell down due to dot com bubble burst. At the same India was slightly affected by it and China was not much affected by this. The global financial crises of 2007-2009 were the widest of all the post reform recessions and affected all the three

economies. The GDP growth had dipped down drastically of all the three economies. At that time Chinese economy was at the peak and after this recession its GDP growth fell from 14.23 percent to 9.65 in 2008 and 9.4 percent in 2009. From henceforth Chinese economy was unable to maintain double digit GDP growth. Indian economy was also equally affected in this period and showed a dramatic fall from 9.8 percent in 2007 to 3.89 in 2008. At the same time India started to recover in 2009 with 8.48 percent and in 2010 India showed highest GDP growth i.e. 10.26 percent. And when we talk of US economy at the same time it was declined to its lowest and showed negative GDP growth of -0.29 percent in 2008 and -2.78 percent in 2009 which is the lowest of all the time. The year 2010 was proved best for India and USA they reached its pinnacle during this period. Post 2010 the GDP growth of all the three economies was slow and constant.

Table 3.2 GDP Growth of India

Period	Average	Min	Max	Variance
1991	1.06	1.06	1.06	0
1992-1996	6.402	4.75	7.57	1.58197
1997-1998	5.115	4.05	6.18	2.26845
1999-2000	6.345	3.84	8.85	12.55005
2001-2002	4.31	3.8	4.82	0.5202
2003-2006	8.58	7.86	9.28	0.635467
2007-2009	6.845	3.89	9.8	9.6231
2010-2017	7.2625	5.46	10.26	2.07925

Source: Calculated by author through MS Excel

GDP of India is slower during recessionary period as compared to normal period. In some normal period also there was slower growth of GDP in India especially in 1999-2000 it fell down drastically. India accounted its highest GDP growth in 2003-2006.

Table 3.3 GDP Growth of China

Period	Average	Min	Max	Variance
1991	9.29	9.29	9.29	0
1992-1996	12.404	9.93	14.22	3.52478
1997-1998	8.535	7.84	9.23	0.96605
1999-2000	8.08	7.67	8.49	0.3362
2001-2002	8.735	8.34	9.13	0.31205
2003-2006	11.0675	10.04	12.72	1.604625
2007-2009	11.94	9.65	14.23	7.394633
2010-2017	7.95	6.7	10.64	1.999771

Source: Calculated by author through MS Excel

We can notice the impact of recession on China's GDP growth only during second recessionary period i.e. 1997-1998, otherwise it did not show any increase or decrease as such in the recessionary periods. Its GDP growth did not show much variance from 1997-2002. China's GDP growth was highest in 1992-1996 that is one of the normal periods and second highest GDP growth was registered in 2007-2009 which was one of the recessionary periods.

Table 3.4 GDP growth of USA

Period	Average	Min	Max	Variance
1991	-0.07	-0.07	-0.07	0
1992-1996	3.374	2.72	4.04	0.36918
1997-1998	4.47	4.45	4.49	0.0008
1999-2000	4.39	4.09	4.69	0.18
2001-2002	1.385	0.98	1.79	0.32805
2003-2006	3.155	2.67	3.79	0.265167
2007-2009	0.745	-0.29	1.78	5.2131
2010-2017	2.1525	1.49	2.86	0.257593

Source: Calculated by author through MS Excel

During 2001-2002 and 2007-2009 the GDP growth of USA was decreasing in itself and as compared to normal period, so these recessionary periods had an impact on the GDP growth of USA. We can now notice from the variance that GDP growth of USA was not much varied except in 2007-2009 because this recessionary period hit USA the hardest. From the average we can notice that USA accounted least growth in 2007-2009 and highest growth in 1997-1998. In the first two normal periods GDP was increasing then started to decrease in the next two normal periods.

3.3 Pattern of movement of Inflation in India, China and USA

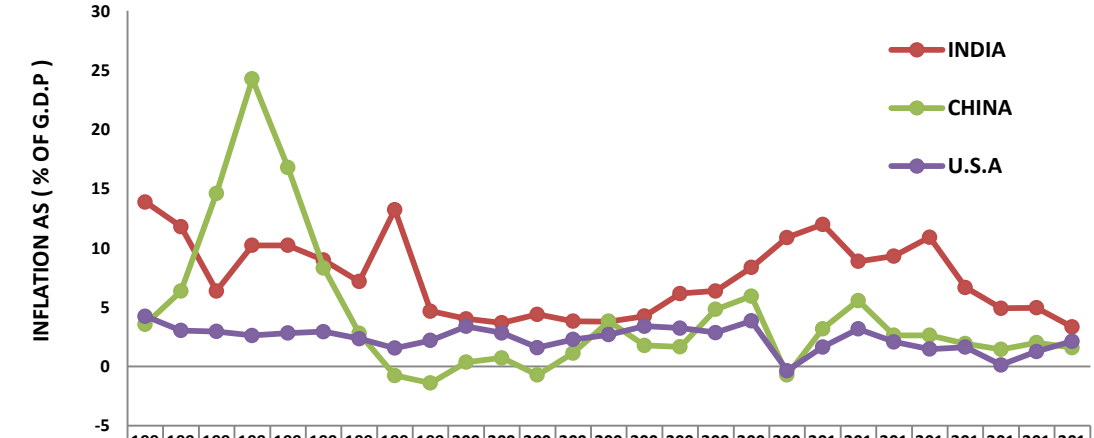
Table 3.5 Annual Percentage of Inflation (consumer price) 1991-2017

Year	Inflation in India	Inflation in China	Inflation in USA	Category of Period
1991	13.87	3.56	4.23	Recession
1992	11.79	6.35	3.03	Normal
1993	6.36	14.61	2.95	Normal
1994	10.21	24.26	2.61	Normal
1995	10.22	16.79	2.81	Normal
1996	8.98	8.31	2.93	Normal

1997	7.16	2.79	2.34	Recession
1998	13.23	-0.77	1.55	Recession
1999	4.67	-1.4	2.19	Normal
2000	4.01	.35	3.38	Normal
2001	3.68	0.72	2.83	Recession
2002	4.39	-0.73	1.59	Recession
2003	3.81	1.13	2.27	Normal
2004	3.77	3.82	2.68	Normal
2005	4.25	1.78	3.39	Normal
2006	6.15	1.65	3.23	Normal
2007	6.37	4.82	2.85	Recession
2008	8.35	5.93	3.84	Recession
2009	10.88	-.73	-.36	Recession
2010	11.99	3.18	1.64	Normal
2011	8.86	5.55	3.16	Normal
2012	9.31	2.62	2.07	Normal
2013	10.91	2.62	1.46	Normal
2014	6.66	1.92	1.62	Normal
2015	4.91	1.44	.12	Normal
2016	4.95	2.0	1.26	Normal
2017	3.33	1.59	2.13	Normal

Source: World Development Indicators

FIGURE 3.2 INFLATION AS PERCENTAGE OF G.D.P (1991- 2017)



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
INDIA	13.9	11.8	6.36	10.2	10.2	8.98	7.16	13.2	4.67	4.01	3.68	4.39	3.81	3.77	4.25	6.15	6.37	8.35	10.9	12	8.86	9.31	10.9	6.66	4.91	4.95	3.33
CHINA	3.56	6.35	14.6	24.3	16.8	8.31	2.79	-0.8	-1.4	0.35	0.72	-0.7	1.13	3.82	1.78	1.65	4.82	5.93	-0.7	3.18	5.55	2.62	2.62	1.92	1.44	2	1.59
U.S.A	4.23	3.03	2.95	2.61	2.81	2.93	2.34	1.55	2.19	3.38	2.83	1.59	2.27	2.68	3.39	3.23	2.85	3.84	-0.4	1.64	3.16	2.07	1.46	1.62	0.12	1.26	2.13

In this figure inflation as percentage of GDP has been depicted from post reform period till 2017 of India, China and USA. We can see from the figure that India faces inflation between 3 to 14 percent from the post reform period. In 1991 it was highest

i.e. 13.87 and lowest in the year 2017 that is 3.33 percent. From the above data we can see that India faces high inflation rate during recessions except the dot com bubble burst in the year 2001 and 2002. On the other hand when we look at Chinese economy it faces inflation between 25 to -1.4 percent. From the year 1993 to 1995 it faces highest inflation i.e. 24.26 percent among all the three economies, it is due to adjustment and reform policy of China. During the recession period Chinese economy faces deflation rate except in 1991. In the US economy the inflation rate was between 4.23 to -0.36 percent. The highest was in the year 1991 that is 4.23 percent and it was lowest in the year 2009 i.e. -0.36 percent and it is called deflation. In the other two recessionary period inflation rates was nominal as per whole data of this economy.

Table 3.6 Inflation in India

Period	Average	Min	Max	Variance
1991	13.87	13.87	13.87	0
1992-1996	9.512	6.36	11.79	4.09897
1997-1998	10.195	7.16	13.23	18.42245
1999-2000	4.34	4.01	4.67	0.2178
2001-2002	4.035	3.68	4.39	0.25205
2003-2006	4.495	3.77	6.15	1.264633
2007-2009	7.36	6.37	10.88	5.110233
2010-2017	7.615	3.33	11.99	9.730457

Source: Calculated by author through MS Excel

The inflationary effect was more during recessionary period in India as compared to normal period except in 2001-2002. The variance value shows that there was inflationary impact in India except during 1999-2002 and in 2003-2006 whereas the inflationary impact was high in 1992-1996 and 2010 -2017.

Table 3.7 Inflation in China

Period	Average	Min	Max	Variance
1991	3.56	3.56	3.56	0
1992-1996	14.064	6.35	24.26	51.07548
1997-1998	1.01	-0.77	2.79	6.3368
1999-2000	-0.525	-1.4	0.35	1.53125
2001-2002	-0.005	-0.73	0.72	1.05125
2003-2006	2.095	1.13	3.82	1.401367
2007-2009	5.375	4.82	5.93	12.7317
2010-2017	2.615	1.44	5.55	1.746571

Source: Calculated by author through MS Excel

Till 1995 inflation was very high in China due to policy reforms, because of it during 1992-1996 the variance value was high. Many times inflation was negative in China especially during 1997-2002. Only in 2007-2009 there was inflationary impact on Chinese economy. During normal periods inflation was high during 1992-1996 and even negative in 1999-2000.

Table 3.8 Inflation in USA

Period	Average	Min	Max	Variance
1991	4.23	4.23	4.23	0
1992-1996	2.866	2.61	3.03	0.02668
1997-1998	1.945	1.55	2.34	0.31205
1999-2000	2.785	2.19	3.38	0.70805
2001-2002	2.21	1.59	2.83	0.7688
2003-2006	2.8925	2.27	3.39	0.264692
2007-2009	3.345	2.85	3.84	4.8207
2010-2017	1.6825	0.12	3.16	0.744079

Source: Calculated by author through MS Excel

In USA we cannot see much variance in inflation except during 2007-2009 because during this recession US economy was adversely affected. Inflation decreases during 1997-1998 and 2001-2002 as compared to previous normal period. During 2007-2009 inflation was high in USA. In the normal periods inflation rate was decreasing except in 2003-2006.

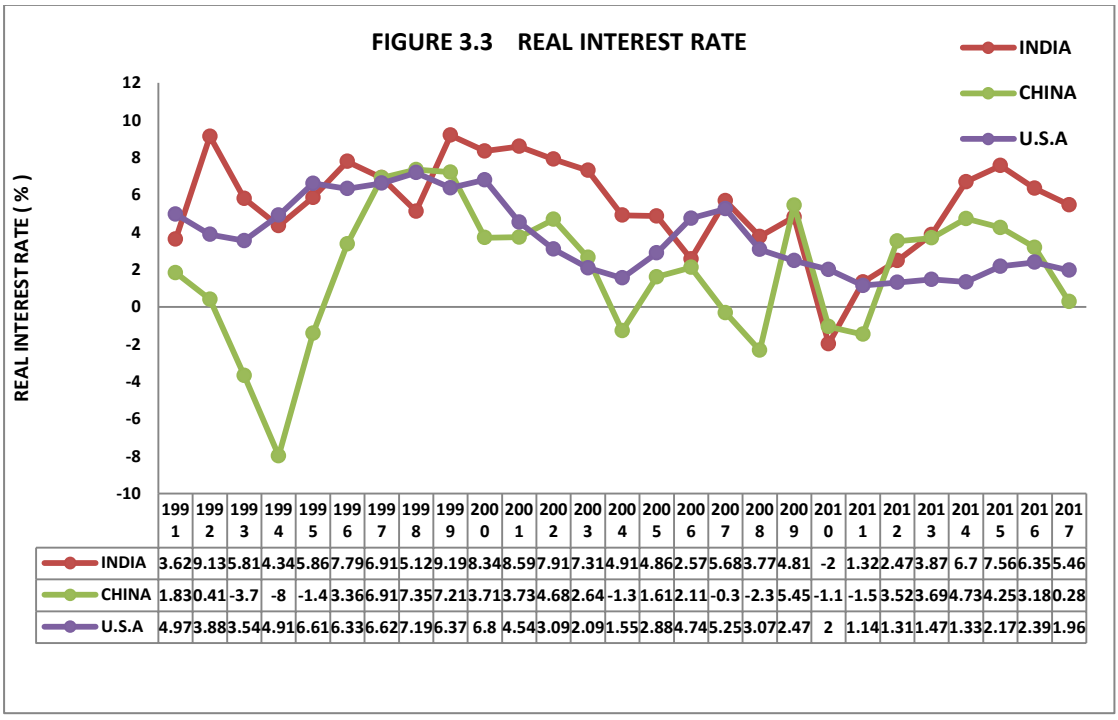
3.4 Pattern of movement of Real Interest Rate in India, China and USA

Table 3.9 Real Interest Rate of India, China and USA (1991 -2017)

Year	Real Interest Rate of India	Real Interest Rate of China	Real Interest Rate of USA	Category of Period
1991	3.62	1.83	4.97	Recession
1992	9.13	.41	3.88	Normal
1993	5.81	-3.67	3.54	Normal
1994	4.34	-7.98	4.91	Normal
1995	5.86	-1.42	6.61	Normal
1996	7.79	3.36	6.33	Normal
1997	6.91	6.91	6.62	Recession
1998	5.12	7.35	7.19	Recession
1999	9.19	7.21	6.37	Normal
2000	8.34	3.71	6.80	Normal

2001	8.59	3.73	4.54	Recession
2002	7.91	4.68	3.09	Recession
2003	7.31	2.64	2.09	Normal
2004	4.91	-1.28	1.55	Normal
2005	4.86	1.61	2.88	Normal
2006	2.57	2.11	4.74	Normal
2007	5.68	-0.31	5.25	Recession
2008	3.77	-2.33	3.07	Recession
2009	4.81	5.45	2.47	Recession
2010	-1.98	-1.06	2.00	Normal
2011	1.32	-1.47	1.14	Normal
2012	2.47	3.52	1.31	Normal
2013	3.87	3.69	1.47	Normal
2014	6.7	4.73	1.33	Normal
2015	7.56	4.25	2.17	Normal
2016	6.35	3.18	2.39	Normal
2017	5.46	0.28	1.96	Normal

Source: World Development Indicators



As Chinese economy is considered to be a surplus economy, so it's real interest rate showing more negative trends. As we look back the data of real interest rate of China we can analyze that in the period of 27 years, 8 years are showing negative interest rate. During the Asian financial crises it has highest interest rate of 7.3 percent. As we move forward towards India in only one year we can see that it is showing negative interest rate in 2010. During the year 1992 it shows highest rate of interest i.e. 9.1

percent. During the recessionary period Indian economy is showing high rate of interest. And when we talk of US economy there was no negative interest rate in the period of 27 years. Like Indian economy US also showing high rate of interest during recessionary periods. During the year 1998 US economy had shown highest rate of interest i.e. 7.1 percent. As Indian and US economy is a deficit economy that is why their rate of interest is high as compared to China.

Table 3.10 Interest Rate of India

Period	Average	Min	Max	Variance
1991	3.62	3.62	3.62	0
1992-1996	6.586	4.34	9.13	3.52383
1997-1998	6.015	5.12	6.91	1.60205
1999-2000	8.765	8.34	9.19	0.36125
2001-2002	8.25	7.91	8.59	0.2312
2003-2006	4.9125	2.57	7.31	3.746025
2007-2009	4.725	3.77	5.68	0.914433
2010-2017	3.96875	-1.98	7.56	10.41578

Source: Calculated by author through MS Excel

The interest rate of India was low during recessionary period as compared to normal periods. Interest rate of India was much varied during 1999-2002 and 2007-2008 but it showed high variance in 2010-2017. During first two normal periods the interest rate was increasing then started to decrease in 2003-2006 and rose again in 2010-2017.

Table 3.11 Interest Rate of China

Period	Average	Min	Max	Variance
1991	1.83	1.83	1.83	0
1992-1996	-1.86	-7.98	3.36	18.33135
1997-1998	7.13	6.91	7.35	0.0968
1999-2000	5.46	3.71	7.21	6.125
2001-2002	4.205	3.73	4.68	0.45125
2003-2006	1.27	-1.28	2.64	3.066867
2007-2009	-1.32	-2.33	5.45	16.29773
2010-2017	2.14	-1.47	4.73	6.182914

Source: Calculated by author through MS Excel

In the year 1997-1998 interest rate of China was highest but in rest of the recessionary periods interest rate was decreasing and even negative in 2007-2009. In 1992-1996 interest rate was negative and then increased to 5.46 during 1999-2000 and again decrease to 1.27 in 2003-2006 and again rose up to 2.14 in 2010-2017. The variance in normal period was high in 1992-1996 and 2010-2017, while in recessionary period it was high in 2007-2009.

Table 3.12 Interest Rate of USA

Period	Average	Min	Max	Variance
1991	4.97	4.97	4.97	0
1992-1996	5.054	3.54	6.61	1.93513
1997-1998	6.905	6.62	7.19	0.16245
1999-2000	6.585	6.37	6.8	0.09245
2001-2002	3.815	3.09	4.54	1.05125
2003-2006	2.815	1.55	4.74	1.945233
2007-2009	4.16	3.07	5.25	2.140133
2010-2017	1.72125	1.14	2.39	0.215213

Source: Calculated by author through MS Excel

The interest rate of US economy did not show much variance, the highest variance of USA was 2.14 during 2007-2009. The US economy showed increased interest rate during recessionary period except in 2001-2002. During the first two normal periods interest rate were increasing and in the next two normal periods it showed a decreasing trend.

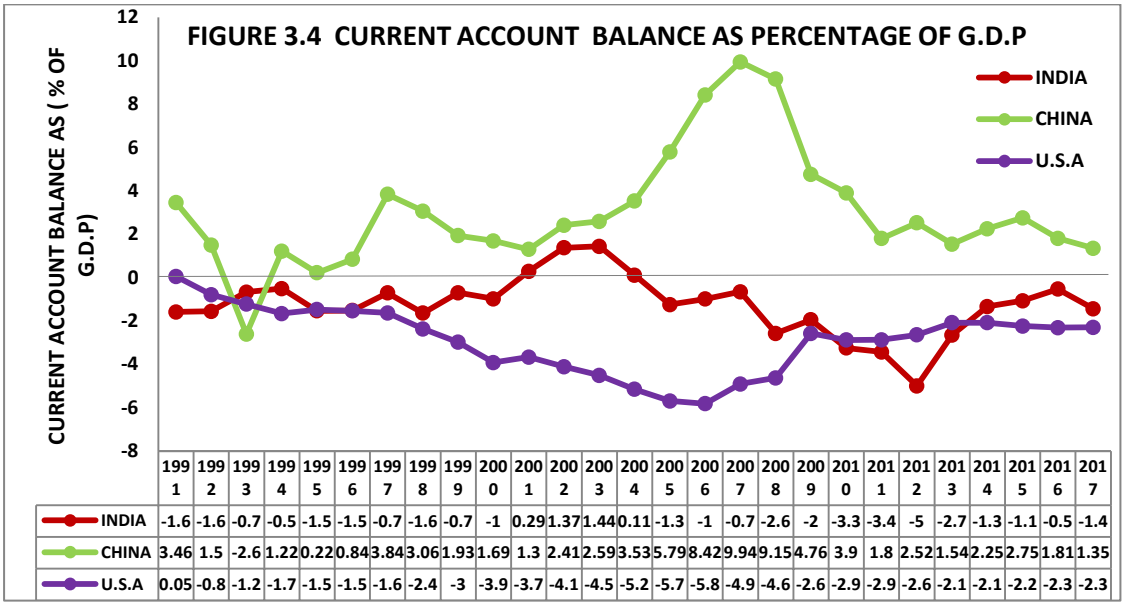
3.5 Pattern of movement of Current Account Balance

Table 3.13 Current Account Balance as Percentage of Gross Domestic Product (1991-2017)

Year	C.A.B of India	C.A.B of China	C.A.B of U.S.A	Category of Period
1991	-1.59	3.46	0.05	Recession
1992	-1.56	1.50	-0.79	Normal
1993	-0.67	-2.61	-1.23	Normal
1994	-0.51	1.22	-1.66	Normal
1995	-1.54	0.22	-1.48	Normal
1996	-1.52	0.84	-1.54	Normal
1997	-0.71	3.84	-1.63	Recession
1998	-1.64	3.06	-2.37	Recession

1999	-0.70	1.93	-2.98	Normal
2000	-0.98	1.69	-3.92	Normal
2001	0.29	1.30	-3.67	Recession
2002	1.37	2.41	-4.11	Recession
2003	1.44	2.59	-4.51	Normal
2004	0.11	3.53	-5.15	Normal
2005	-1.25	5.79	-5.69	Normal
2006	-0.99	8.42	-5.82	Normal
2007	-0.66	9.94	-4.91	Recession
2008	-2.58	9.15	-4.63	Recession
2009	-1.95	4.76	-2.58	Recession
2010	-3.25	3.90	-2.88	Normal
2011	-3.43	1.80	-2.87	Normal
2012	-5.0	2.52	-2.64	Normal
2013	-2.65	1.54	-2.08	Normal
2014	-1.34	2.25	-2.08	Normal
2015	-1.07	2.75	-2.24	Normal
2016	-0.53	1.81	-2.31	Normal
2017	-1.44	1.35	-2.30	Normal

Source: World Development Indicators



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
INDIA	-1.6	-1.6	-0.7	-0.5	-1.5	-1.5	-0.7	-1.6	-0.7	-1	0.29	1.37	1.44	0.11	-1.3	-1	-0.7	-2.6	-2	-3.3	-3.4	-5	-2.7	-1.3	-1.1	-0.5	-1.4
CHINA	3.46	1.5	-2.6	1.22	0.22	0.84	3.84	3.06	1.93	1.69	1.3	2.41	2.59	3.53	5.79	8.42	9.94	9.15	4.76	3.9	1.8	2.52	1.54	2.25	2.75	1.81	1.35
U.S.A	0.05	-0.8	-1.2	-1.7	-1.5	-1.5	-1.6	-2.4	-3	-3.9	-3.7	-4.1	-4.5	-5.2	-5.7	-5.8	-4.9	-4.6	-2.6	-2.9	-2.9	-2.6	-2.1	-2.1	-2.2	-2.3	-2.3

The figure 3.4 shows the trend of current account balance of India, China and USA. Indian economy is a deficit economy and almost shows negative trend in terms of current account balance. Its highest deficits were during the period 2010-2012. Of the four recessionary periods its deficit had been increased in 1998 and 2008. The current account balance was in surplus from the year 2001 to 2004 while in 1991 its deficit showed slightest decrease to -1.59 percent as it was -2.19 percent in 1990. From the data we can see that Chinese economy was always a surplus economy. During the

global financial crises its surplus was highest i.e. 9.94 percent in 2007 and 9.15 percent in 2008. During recessionary periods its surplus had been increasing. In the year 1993 it had a deficit current account balance of -2.61 percent. Now if we talk of US economy it is also a deficit economy. It was in surplus during 1991 and from 1992 its deficit had been increasing till 2006. During the two periods of recession its deficit had been declined whereas in 1998 its deficit was slightly increased as US economy was unaffected in this period of recession. One thing is also noticeable that when US economy was at its peak in terms of its deficit at that time Chinese economy was in high surplus.

Table 3.14 CAB of India

Period	Average	Min	Max	Variance
1991	-1.59	-1.59	-1.59	0
1992-1996	-1.16	-1.56	-0.51	0.27415
1997-1998	-1.175	-1.64	-0.71	0.43245
1999-2000	-0.84	-0.98	-0.7	0.0392
2001-2002	0.83	0.29	1.37	0.5832
2003-2006	-0.1725	-1.25	1.44	1.503092
2007-2009	-1.62	-2.58	-0.66	0.9579
2010-2017	-2.33875	-5	-0.53	2.269555

Source: Calculated by author through MS Excel

Current Account Balance of India mostly showed negative balance, that means India is a deficit economy, but there was not much variance, the highest variance was during 2010-2017 that is 2.26. In 1997-1998 and 2007-2009 the deficit was increasing as compared to previous normal period and Indian economy was in surplus in 2001-2002. During normal period deficit was decreasing in India except in 2010-2017.

Table 3.15 CAB of China

Period	Average	Min	Max	Variance
1991	3.46	3.46	3.46	0
1992-1996	0.234	-2.61	1.5	2.75768
1997-1998	3.45	3.06	3.84	0.3042
1999-2000	1.81	1.69	1.93	0.0288
2001-2002	1.855	1.3	2.41	0.61605
2003-2006	5.0825	2.59	8.42	6.754092
2007-2009	9.545	9.15	9.94	7.7881
2010-2017	2.24	1.35	3.9	0.679257

Source: Calculated by author through MS Excel

China is a surplus economy because its Current Account Balance was mostly positive which means that exports are more than imports. We can notice that Chinese economy showed much variance in Current Account Balance comparative to India. Compared to previous normal periods surpluses are increasing during recessionary periods. Also during normal periods surpluses are increasing except in 2010-2017.

Table 3.16 CAB of USA

Period	Average	Min	Max	Variance
1991	0.05	0.05	0.05	0
1992-1996	-1.34	-1.66	-0.79	0.11915
1997-1998	-2	-2.37	-1.63	0.2738
1999-2000	-3.45	-3.92	-2.98	0.4418
2001-2002	-3.89	-4.11	-3.67	0.0968
2003-2006	-5.2925	-5.82	-4.51	0.356292
2007-2009	-4.77	-4.91	-2.58	1.6183
2010-2017	-2.425	-2.88	-2.08	0.107486

Source: Calculated by author through MS Excel

The US economy is a deficit economy like Indian economy. In 1997-1998 and 2001-2002 deficits were increasing in US economy as compared to its previous normal period while its deficits decreased in 2007-2009.Current Account Balance of USA was not much varied comparative to India and China, its highest variance was 1.61 in 2007-2009. In normal period deficits kept on increasing except in 2010-2017.

3.6 Conclusion:

After comparing the three economies it is concluded that India and China is growing swiftly in terms of its fundamental variables. On the other hand fundamental variables of US economy are not performing well as compared to India and China. After the reforms China is the fastest growing economy of the world and India is an emerging economy and is performing well in terms of economic growth. In terms of recessions India was affected by almost all four recessionary periods. Its fundamental variable movements were not as per recession in one or two year of recessions. US economy was adversely hit by the global financial crises and dot com bubble burst i.e. 2001-2002 and 2007-2009. On the other hand China was least affected by recessions, only in one or two year of recessions its fundamental variables moves as per recessions.

From the trend analysis of fundamental variables of the Indian economy we can conclude that the GDP growth of India slowdown and interest rate were also cut down in almost all recessionary period except in 2007-2009. On the other hand inflation was also increased in almost every recessionary period except in 1997 and 2001. Current account deficits of India were reduced in 1997 and 2007-2009 as a result of recession. On the other hand when we look at the movement of fundamental variables of China, it is concluded that its fundamental variables were least affected by the recessions. The interest rate of China was affected only in 2007 and 2008 as while its inflation was increased only in 2001, 2007 and 2008. The current account balance was not affected by recession at all and its GDP growth slowdown only in 1998. The trend analysis of fundamental variables shows that its GDP growth was hit by three recessionary periods that is 1991, 2001-2002 and 2007-2009, on the other hand inflation was increased only in the year 2008. The interest rate and current account deficits of US economy were reduced in 2001-2002 and 2007-2009. The variance was least in USA with respect to the movement of fundamental variables which proves that its fundamental variables are not performing. At the same time India and China showed variations with respect to the movement of fundamental variable. The impact of recession is also different in the respective economies. So we can conclude that the trends are not similar in the three countries during recessionary and normal periods. The fundamental variables of the three economies are following dissimilar trends and affected differently by recessions.

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CHAPTER 4

ANALYSIS OF VARIATION IN EXCHANGE RATE WITH RESPECT TO MOVEMENT OF FUNDAMENTAL VARIABLES

4.1 Introduction

In the earlier chapter I already explained the movement of fundamental variables regarding India, China and USA. This chapter analyze the variation in exchange rate of the country with respect to movement of macro variables such as GDP growth, interest rate, inflation and current account balance in normal period as well as in recession. At the same time this chapter compares the variation of India, China, and USA.

The exchange rate is the price of one currency relative to another currency. Since exchange rate has a direct impact on international price of goods and services on international prices of goods and services as well as financial assets. Exchange rates are very much volatile nowadays after the collapse of Bretton woods system in 1973 since then lots of research has been undertaken to understand the behavior of movements of exchange rate.

The exchange is the most important price in any economy, for it affects all other prices. In most countries, policy towards the national currency is prominent and controversial. Economic epochs are often characterized by the prevailing exchange rate system-the Gold Standard Era, The Bretton Woods Era. Contemporary development from the creation of an economic and monetary union to successive waves of currency crisis, reinforce the centrality of exchange rate to economic trends i.e. Floating Exchange Era.

International monetary regimes tend towards one of the two ideal types. The first is the fixed rate system in which currencies are tied to each other at publicly announced rates. Some fixed rate system involves a common link to commodities such as gold/silver, others peg to a national currency such as US dollar, Euro etc. The second ideal and typical monetary regime is free floating in which national currency value varies with market conditions and national macroeconomic policies. Nowadays one more regime is introduced that is managed exchange rate system in which there is government intervention to some extent.

The exchange rate is such a important rate that politicians may wish to manipulate it for the purpose of winning elections, rather than stabilizing an international regime.

Two fundamental currency decisions confront policy makers and each has distributional consequences. First policy makers must decide whether to heed external signals and join the dominant international or regional regime. Second for all but irrevocably fixed rate regimes, policy makers also confront choices involving the level of exchange rate, the price at which the national currency trades in foreign exchange markets. All these concepts are explained in depth in chapter two.

Determinants of exchange rate in free market:

The determinants of exchange in free markets are classified as long run and short run. Long run factors work through product and labor markets, short run ones are linked to changes in domestic and international financial markets.

Changing inflation rates, differences in interest rates or changes in expected exchange rates, all have an impact on currency exchange rates in the short run. As inflation slows, domestic interest rates increases or for interest rates drops, they all lead to a higher demand for the domestic currency and as a result the value of currency increases or appreciates. Conversely as the demand for currency drops in a domestic/international market the currency depreciates or loses its value relative to other currency. The major long run factors determining exchange rate are trade policies, differences in price levels of product in domestic versus foreign countries, differences in productivity and preferences for foreign versus domestic products.

The debate over the relationship of a fundamental variables and exchange rate has been widely propagated through the due course of the time. As we can observe through literature that many researchers and economist are of view that there is a link between fundamental variables and exchange rate in short run whereas other school of economist propounded that there is a link between fundamental variable and exchange rate in long run. On the other hand some of the economists say that there is a relationship varies from economy to economy. So this chapter emphasizes on the correlation between exchange rate and fundamental variables during normal period as well as during recession. Exchange rate in this chapter is taken against SDR.

4.2 Exchange rate system: Post- reform period

4.2.1 Exchange rate system in India

India has a managed floating exchange rate system where the exchange rate of the rupee with another currency is determined by the market factors of supply and demand and sometimes whenever needed government/RBI intervenes in the exchange rate system of India. Before 1992 India had a fixed exchange rate system but after 1992 RBI discontinued the fixed exchange rate system due to ineffectiveness of monetary policy. Economic liberalization or economic reform of 1990 resulted in the adaptation of floating exchange rate system of India.

4.2.2 Exchange rate system of China

China struggled to evolve from an underdeveloped market to a central player across the world economy; it has experienced growing pains and faced policy reforms that have frequently sent shockwaves through market around the world. Foreign exchange policies have been main attempts to ease into a position as a leading world economy while promoting the Yuan as a global reserve currency. Unlike many other countries that allow the value of their currency to float freely, China has controlled its currency policy strictly. It regulates the trading activities and tries to control daily movements of the Yuan on the forex market. In order to have economic stability, China fixed its exchange rate in 1995. In August 2015 China took a step further by allowing its currency to devalue outside of the previous trading i.e. government could consider previous day trading in the establishment of the currency rate.

A large apart f of Chinas reserve are denominated in US dollars and are invested in US treasury bonds, which are deemed to be safe haven for capital among major central banks around the globe. It is estimated that China is the largest single nation holder of US bonds, with approximately US $ 1.25 trillion of these securities.

4.2.3 USA exchange rate system

Most major countries with established stable economic market use a floating exchange rate. The US economy uses floating exchange rate. Floating exchange rates are determined by the market based upon supply and demand. US currency is the dominating currency across the world economy. It is also known as global currency.

4.2.4 Exchange Rates in Long Run and Short run

Like any other goods and services, exchange rates are also determined by the interaction of supply and demand.

Factors affecting exchange rate in long run

- Price level: In the long run, an increase in a country's price level relative to the foreign price level causes currency to lose its value, and a fall in the country's relative price level causes its currency to gain the value.
- Preferences for Domestic versus Foreign Goods: A rise in the demand for country's export causes its currency to appreciate; conversely, increased demand for imports causes the domestic currency to depreciate in the long run.
- Productivity: If a country becomes more productive relative to other countries, its currency appreciates in the long run.

Factors affecting exchange rate in short run

- Foreign interest rate: An increase in the foreign interest rate causes domestic currency to depreciate and vice versa..
- Domestic interest rate: A rise in domestic interest rate causes an appreciation in domestic currency and vice versa.

4.2.5 Special Drawing Rights

The SDR is an international reserve asset created by the IMF in 1969 to supplement its member countries' official reserve. The SDR was created as supplementary international reserve asset in the context of the Bretton Woods fixed exchange rate system. The collapse of the Bretton Woods system in 1973 and the shift of major currencies to floating exchange rate regimes lessened the reliance on the SDR as a global reserve asset. [10]

The SDR serves as the unit of account of the IMF and some other international organization. The SDR is neither a currency nor a claim on the IMF. Rather, it is a potential claim on the freely usable currencies of IMF members. SDR's can be exchanged for these currencies. [10]

After the collapse of Bretton Woods system, the SDR was redefined as a basket of currencies. The SDR basket id reviewed every five years or earlier if warranted, to ensure that the SDR reflects the relative importance of currencies in the worlds trading financial systems. The reviews cover the key element of the SDR method of valuation including criteria and indicators used in selecting SDR basket currencies and the initial currency weights used in determining the amount of each currency in the SDR baskets. These currency amounts remain fixed over the five years. SDR valuation period but the actual rates of the currency in the baskets fluctuate as cross exchange rates among the basket currencies move. The value of the SDR is determined daily based on market exchange rates. The reviews are also used to access the appropriateness of the financial instruments comprising the SDR interest rate basket. The SDR interest rate is the interest paid to members on their SDR holdings and charged on their SDR allocation. The SDRi value is determined weekly based on a weighted average of representative interest rate on short term government debts instruments in the money market of the SDR basket currencies, with a floor of five basis points. The members can buy and sell SDRs in the voluntary market. If required, the IMF can also designate members to buy SDRs. [10]

4.3 Variation in exchange rate with respect to movement of GDP growth

The previous literature will give some insights for the correlation between GDP and foreign exchange rate. According to Rodrik (2008) the exchange rate does matter for growth in developing country, but substantially less so in advanced ones. As weak exchange rate compensates for institutional weaknesses and market failure which leads to underinvestment in the traded goods in developing countries. According to him growth acceleration takes place, on average, after ten years of steady increase in undervaluation in developing countries. Aguirre and Calderon (2005) find that undervaluation hurt growth, while modest undervaluation enhances growth. There is relatively a mass of literature available on the correlation between exchange rate and GDP growth. When a country's economy falters, consumer spending declines and trading sentiment for its currency turns sour, leading to a decline in that country's currency against other currencies with stronger economies. On the other hand, a booming economy will lift the value of its currency, if there is no government intervention to restrain it.

In the figures given below broken lines denotes SDR of respective countries and normal line denotes GDP growth. The comparison was divided into three sub parts firstly Indian and Chinese economy is compared, then USA and Indian economy is compared and lastly USA and Chinese economy is compared. In this trend analysis three figures have been shown to analyze the trend of the three economies.

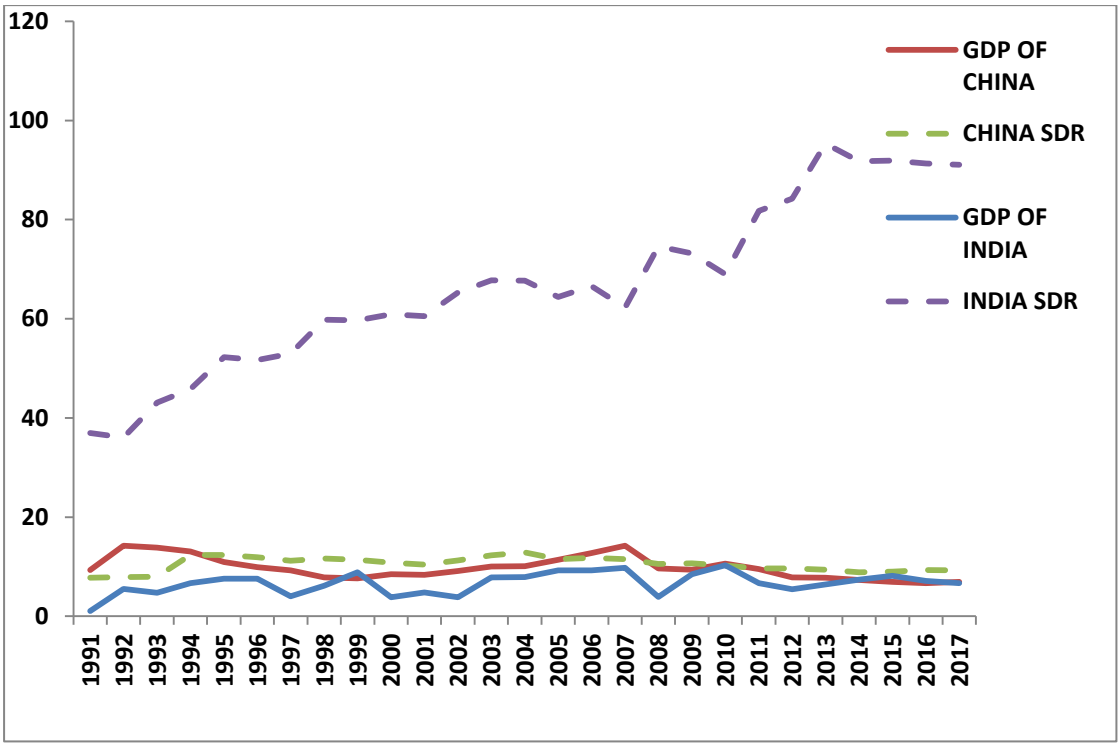
Table 4.1 GDP growth and Exchange Rate of China and India

Year	GDP of China	China SDR	GDP of India	India SDR	GDP Differential	CNY/INR
1991	9.29	7.77	1.06	36.95	8.23	4.25
1992	14.22	7.91	5.48	36.03	8.74	5.09
1993	13.87	7.97	4.75	43.1	9.12	5.41
1994	13.05	12.33	6.66	45.81	6.39	3.63
1995	10.95	12.36	7.57	52.29	3.38	3.87
1996	9.93	11.93	7.55	51.67	2.38	4.25
1997	9.23	11.17	4.05	53	5.18	4.39
1998	7.84	11.66	6.18	59.81	1.66	5
1999	7.67	11.36	8.85	59.69	-1.18	5.21
2000	8.49	10.78	3.84	60.91	4.65	5.44
2001	8.34	10.4	4.82	60.55	3.52	5.71
2002	9.13	11.25	3.8	65.3	5.33	5.87
2003	10.04	12.3	7.86	67.77	2.18	5.63
2004	10.11	12.85	7.92	67.69	2.19	5.47
2005	11.4	11.53	9.28	64.41	2.12	5.38
2006	12.72	11.75	9.26	66.56	3.46	5.67
2007	14.23	11.54	9.8	62.29	4.43	5.41
2008	9.65	10.53	3.89	74.63	5.76	6.26
2009	9.4	10.7	8.48	73.18	0.92	7.07
2010	10.64	10.2	10.26	69.01	0.38	6.7
2011	9.54	9.67	6.64	81.77	2.9	7.22
2012	7.86	9.67	5.46	84.19	2.4	8.46
2013	7.76	9.4	6.39	95.32	1.37	9.54
2014	7.3	8.87	7.41	91.75	-0.11	9.9
2015	6.9	9	8.15	91.91	-1.25	10.2
2016	6.7	9.34	7.11	91.35	-0.41	10.11
2017	6.9	9.27	6.68	91.04	0.22	9.37

Source: World Development Indicator and International Monetary Fund

Note: Exchange Rate of China and India was unavailable on IMF so it is fetched from trading site FXTOP.com and differential is calculated through MS excel.

Figure 4.1 Trend Analyses of India and China with Respect to GDP Growth and SDR



In the figure 4.1 variations in exchange rate of India and China has been analyzed with respect to the movement of their fundamental variables. The sub-period I or normal period has four period i.e.1992-1996, 1999-2000, 2003-2006, and 2010-2017. During the period of 1992-1996 GDP growth of China was all time higher than India except in some years and the differentials of GDP growth was also high between the two economies in first two years then reduced in the last three years. When we talk of their currency value, in the first two years Renminbi was constant but in the next two year it started to depreciate. On the other hand Indian rupee was also depreciated except in 1992 and 1996. In the period of 1999-2000 GDP growth of India was more than China by 1 percent but the currency rate of both the countries was appreciating in the first year of the period. In the second year again India's GDP growth rate fell down and once again China's GDP growth rate was more than India. So accordingly the currency rate of China was appreciated and currency rate of India had been depreciated. In the period of 2003-2006 GDP growth of China was two digits except in 2005. At the same time GDP growth of India was also good during these years and

the differential between the two countries were also less i.e. 2 percent except in 2006. Currency rate of India was appreciating in 2004-2005 as the difference between the two decreases while it was depreciating in 2003 and 2006. During the period of 2010-2017 the GDP growth of India was higher than China in the three consecutive years that is 2014-2016 and its currency rate was also appreciating at that time except in 2015. While currency rate of China was depreciating in these years but not in 2014. In the year 2010 the difference between the two GDP growths was very nominal so both the country's currency rate was appreciated. Then again from 2011 to 2013 the difference between the two GDP growths had been increased and the booming economy was China so its currency rate was also appreciating.

In the sub-period II also there are four periods i.e. 1991, 1997-1998, 2001-2002, and 2007-2009. In 1991 GDP growth of China was far better than India so is its currency rate. The difference between the two GDP growths was almost of 8 percent. In the period of 1997-1998 the GDP growth of both the countries were declined but China's GDP growth was far better than India. In 1997 the currency rate of China was appreciating but depreciated in the very next year due to the increased GDP growth of India. At the same time currency rate of India also got depreciated. In the year 2001 and 2002 the difference between the GDP growth of India and China was almost of 3 percent and the booming country was China. At the same time Indian rupee was depreciating while Renminbi was appreciating according to the theory. In the next year GDP growth of India was declined while GDP growth of China had been increased and so the differentials. At the same time we can observe that both the currencies were depreciated. In the year 2007 GDP growth of both the countries were among the highest but the differentials does not decreased and the currency value of both the countries were increasing. In the next year both the GDP growths were fell down by almost 5 percent and its differentials were also increased. Consequently the currency value of China was increased but India's currency value was decreased by almost 12 rupees. In 2009 GDP growth of China again fell down, but Indian economy recovered its GDP growth by 5 percent approx, as the GDP of India increased its currency value was also increased while currency value of China was declined in the same year.

Table 4.2 GDP Differential of China and India

Period	Average	Min	Max	Variance
1991	8.23	8.23	8.23	0
1992-1996	6.002	2.38	9.12	9.34072
1997-1998	3.42	1.66	5.18	6.1952
1999-2000	1.735	-1.18	4.65	16.99445
2001-2002	4.425	3.52	5.33	1.63805
2003-2006	2.4875	2.12	3.46	0.421291667
2007-2009	5.095	4.43	5.76	6.252433333
2010-2017	0.6875	-1.25	2.9	2.028735714

Source: Calculated by author through MS Excel

Table 4.3 Exchange Rates of China and India (CNY/INR)

Period	Average	Min	Max	Variance
1991	4.25	4.25	4.25	0
1992-1996	4.45	3.63	5.41	0.595
1997-1998	4.695	4.39	5	0.18605
1999-2000	5.325	5.21	5.44	0.02645
2001-2002	5.79	5.71	5.87	0.0128
2003-2006	5.5375	5.38	5.67	0.018492
2007-2009	5.835	5.41	7.07	0.689033
2010-2017	8.9375	6.7	10.2	1.804193

Source: Calculated by author through MS Excel

From the above tables we can see productivity of China was all time higher than India so its currency was also appreciating. Productivity differential was high during 1992-1996, 2001-2002, and 2007-2009 but Chinese currency was not appreciating much. At the same time we can also notice that in the period 2010- 2017 when differential was least then Chinese Yuan was appreciating at a faster rate.

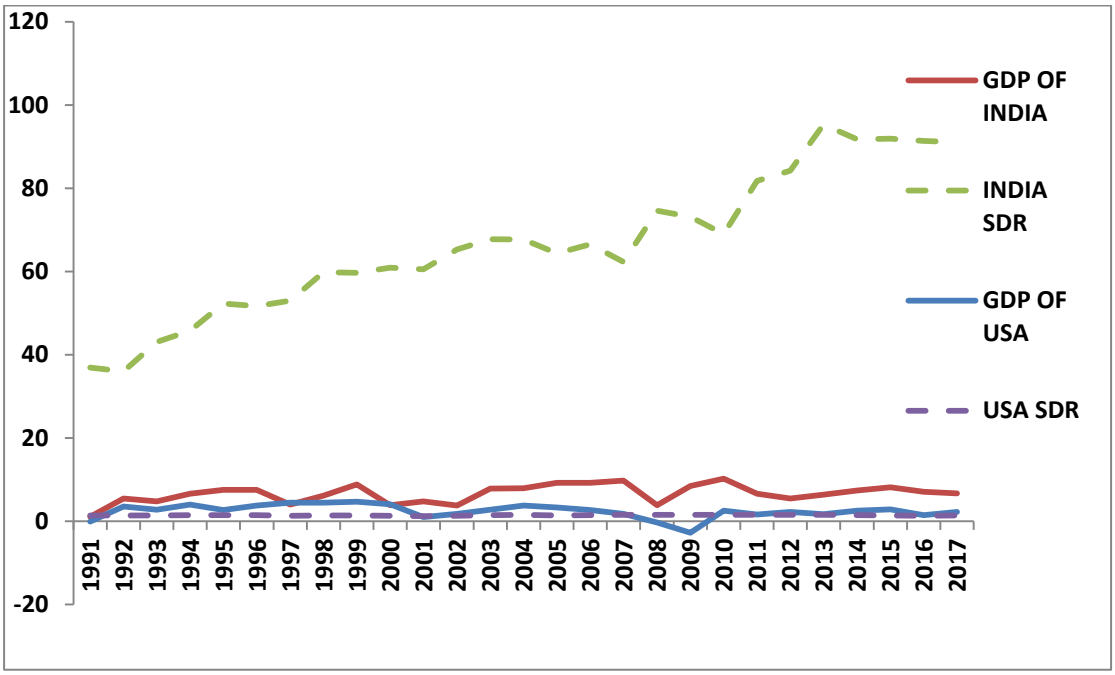
Table 4.4 GDP growth and Exchange Rate of USA and India

Year	GDP of USA	USA SDR	GDP of India	India SDR	GDP Differential	INR/USD
1991	-0.07	1.43	1.06	36.95	-1.13	22.74
1992	3.56	1.38	5.48	36.03	-1.92	25.92
1993	2.75	1.37	4.75	43.1	-2	30.49
1994	4.04	1.46	6.66	45.81	-2.62	31.37
1995	2.72	1.49	7.57	52.29	-4.85	32.43
1996	3.8	1.44	7.55	51.67	-3.75	35.43
1997	4.49	1.35	4.05	53	0.44	36.31

1998	4.45	1.41	6.18	59.81	-1.73	41.26
1999	4.69	1.37	8.85	59.69	-4.16	43.06
2000	4.09	1.3	3.84	60.91	0.25	44.94
2001	0.98	1.26	4.82	60.55	-3.84	47.19
2002	1.79	1.36	3.8	65.3	-2.01	48.61
2003	2.81	1.49	7.86	67.77	-5.05	46.58
2004	3.79	1.55	7.92	67.69	-4.13	45.32
2005	3.35	1.43	9.28	64.41	-5.93	44.1
2006	2.67	1.5	9.26	66.56	-6.59	45.31
2007	1.78	1.58	9.8	62.29	-8.02	41.35
2008	-0.29	1.54	3.89	74.63	-4.18	43.51
2009	-2.78	1.57	8.48	73.18	-11.26	48.41
2010	2.53	1.54	10.26	69.01	-7.73	45.73
2011	1.6	1.54	6.64	81.77	-5.04	46.67
2012	2.22	1.54	5.46	84.19	-3.24	53.44
2013	1.68	1.54	6.39	95.32	-4.71	58.6
2014	2.57	1.45	7.41	91.75	-4.84	61.03
2015	2.86	1.39	8.15	91.91	-5.29	64.15
2016	1.49	1.34	7.11	91.35	-5.62	67.2
2017	2.27	1.42	6.68	91.04	-4.41	65.12

Source: World Development Indicator and International Monetary Fund

Figure 4.2 Trend Analyses of USA and India with Respect to its GDP Growth and SDR



The figure 4.2 variations in exchange rate of India and USA has been analyzed with respect to the movement of their GDP growth. In sub period I there are four periods

viz. 1992-1996, 1999-2000, 2003-2006, and 2010-2017. In the period of 1992-1996 the GDP growth of India was higher than USA during this period. In the year 1992 and 1996 Indian rupee was appreciating while in the rest of years the currency value of India was declining. As the difference in the GDP growth rises the Indian rupee starts to depreciate except in 1996, but US currency appreciates in first two years and in 1996 and it depreciates at a constant rate in 1994 and 1995. In the period 1999-2000 the GDP growth of India was more in 1999 and less in 2000 than US economy. On the other hand when we observe the movement of their exchange rate we get to know that in the first year both the currencies were appreciating and in the next year US currency was constant while Indian rupee depreciates. During the period of 2003-2006 in the very first year the booming country was India and difference between the GDP growth of the two country was also vast i.e. almost 5 percent but both the currencies were depreciating in the same year. In the next year both the GDP growths rises but the difference shrinks. This time Indian rupee increases its value a bit while US currency loses its value at a constant rate. Again in the year 2005 GDP growth of India rises to 9.28 percent consequently its currency value also rises due to the increasing differentials of the two GDP growths. At the same time we can also notice that it does not affect the exchange rate of USA. In 2006 both the GDP growth fell down but the differentials between the two was almost same as it was in 2005 and currency value of both the countries fell down. During the period of seven years that is 2010-2017 in the first year GDP growth of India was highest among 27 years i.e. 10.26 percent while the GDP growth of US was just 2.5 percent the difference between the two was high. As a result the currency value of India was increased and there was no affect on the exchange rate of US Dollars in fact its value rose by 0.03. From 2011 to 2013 the difference between the GDP of US and India shrinks due to declining GDP growth of India as a result Indian currency rate was decreasing drastically like its GDP and US exchange rate was constant. From the year 2014 Indian economy recovered its GDP growth a bit as a result its currency rate also increases but not like 2010.

Table 4.5 GDP differential of USA and India

Period	Average	Min	Max	Variance
1991	-1.13	-1.13	-1.13	0
1992-1996	-3.028	-4.85	-1.92	1.57297
1997-1998	-0.645	-1.73	0.44	6.416159259
1999-2000	-1.955	-4.16	0.25	9.72405
2001-2002	-2.925	-3.84	-2.01	1.67445
2003-2006	-5.425	-6.59	-4.13	1.1433
2007-2009	-6.1	-8.02	-4.18	12.5616
2010-2017	-5.11	-7.73	-3.24	1.625942857

Source: Calculated by author through MS Excel

Table 4.6 Exchange rates of USA and India (INR/USD)

Period	Average	Min	Max	Variance
1991	22.74	22.74	22.74	0
1992-1996	31.12	25.92	35.43	11.94
1997-1998	38.78	36.31	41.26	12.25
1999-2000	44	43.06	44.96	1.76
2001-2002	47.9	47.19	48.61	1.008
2003-2006	45.32	44.1	46.58	1.025292
2007-2009	44.42	41.35	48.41	13.0865
2010-2017	57.74	45.73	67.2	68.84039

Source: Calculated by author through MS Excel

The above tables compare the GDP differential and exchange rate of USA and India, we can observe that GDP was higher in India as compared to the GDP of USA but US dollar was appreciating throughout which is not as per the theory except in 2003-2006 and 2007-2009. GDP differential of the two countries was highest in 2003-2006 and 2007-2009 then Indian currency was appreciating.

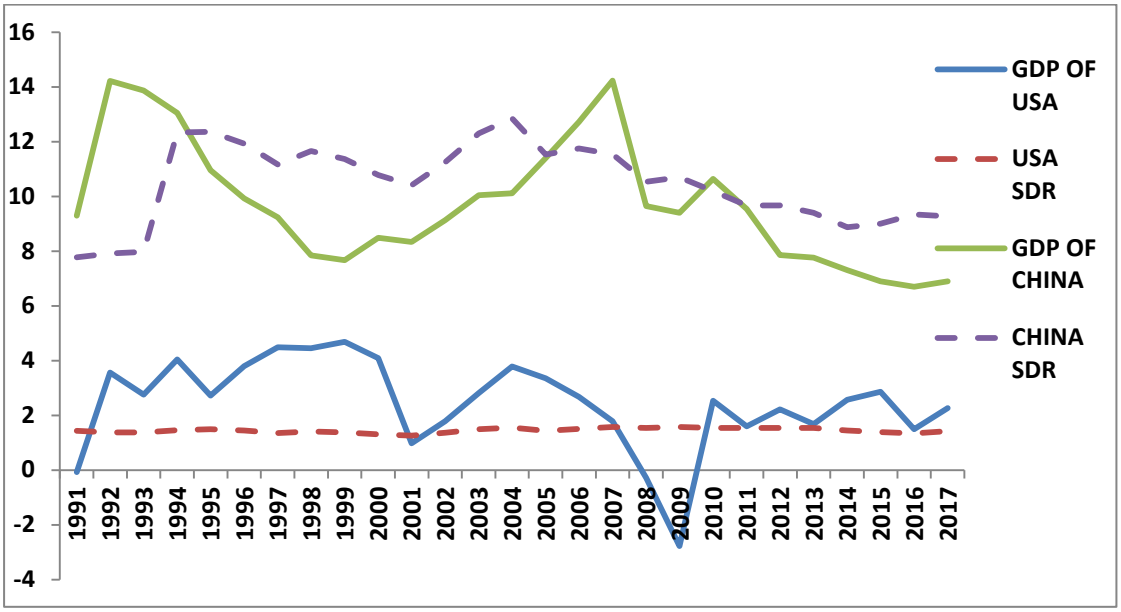
Table 4.7 GDP growth and Exchange Rate of USA and China

YEAR	GDP of USA	USA SDR	GDP of China	China SDR	GDP Differential	RMB/USD
1991	-0.07	1.43	9.29	7.77	-9.36	5.32
1992	3.56	1.38	14.22	7.91	-10.66	5.51
1993	2.75	1.37	13.87	7.97	-11.12	5.76
1994	4.04	1.46	13.05	12.33	-9.01	8.62
1995	2.72	1.49	10.95	12.36	-8.23	8.35
1996	3.8	1.44	9.93	11.93	-6.13	8.31
1997	4.49	1.35	9.23	11.17	-4.74	8.29
1998	4.45	1.41	7.84	11.66	-3.39	8.28

1999	4.69	1.37	7.67	11.36	-2.98	8.28
2000	4.09	1.3	8.49	10.78	-4.4	8.28
2001	0.98	1.26	8.34	10.4	-7.36	8.28
2002	1.79	1.36	9.13	11.25	-7.34	8.28
2003	2.81	1.49	10.04	12.3	-7.23	8.28
2004	3.79	1.55	10.11	12.85	-6.32	8.28
2005	3.35	1.43	11.4	11.53	-8.05	8.19
2006	2.67	1.5	12.72	11.75	-10.05	7.97
2007	1.78	1.58	14.23	11.54	-12.45	7.61
2008	-0.29	1.54	9.65	10.53	-9.94	6.95
2009	-2.78	1.57	9.4	10.7	-12.18	6.83
2010	2.53	1.54	10.64	10.2	-8.11	6.77
2011	1.6	1.54	9.54	9.67	-7.94	6.46
2012	2.22	1.54	7.86	9.67	-5.64	6.31
2013	1.68	1.54	7.76	9.4	-6.08	6.2
2014	2.57	1.45	7.3	8.87	-4.73	6.14
2015	2.86	1.39	6.9	9	-4.04	6.23
2016	1.49	1.34	6.7	9.34	-5.21	6.64
2017	2.27	1.42	6.9	9.27	-4.63	6.76

Source: World Development Indicator and International Monetary Fund

Figure 4.3 Trend Analyses of USA and China with Respect to its GDP Growth and SDR



In the figure 4.3 comparison of China and US economy variations in exchange rate has been analyzed with respect to the movement of their GDP growth. Same as above there are also four period of sub-period I. In the first period that is 1992-1996 differentials of GDP growth was high in the first two years and the booming country

was China but the currency rate of both the country was constant. In the year 1993 the difference between the two GDP growths decreased so both the currency rate depreciates. China's currency rate was more depreciated while US currency rate depreciates at a constant rate. In 1995 the difference decreased by 1 percent in GDP growth of the two but both the currencies depreciate at a constant rate. Again in 1996 the difference decreased to almost 6 percent then both the currencies were appreciating. During second period in the year 1999 the difference between the two GDP growths were decreased to almost 3 percent but the change in currency rate was opposite in case of US economy as both the currencies were appreciating. As the GDP growth of China increased and its opposite happened in US, differences of GDP growths increased in the next year so accordingly Chinese currency increases its value while US currency remains unaffected. In the third period booming country was again China but we can see that as the difference of GDP growth between the two countries decreases both the currency rates decreases and as the difference grow their currency rate increases. In the fourth normal period i.e. 2010-2017, from 2010 to 2013 the US currency rate was constant whatever changes come in the differences of GDP growths. But in case of Chinese economy we can say that as the differences between the two GDP growths shrinks where currency rate of China was increased till 2014. From the year 2015 as the GDP growth of US rises and China's GDP growth declines and so its currency value, while US currency value was increased till 2016. In 2017 both the GDP growths were increased but the difference decreased so currency value of USA was depreciated while Renminbi was appreciating. As a result in the normal period variation in exchange rate with respect to movement of GDP growth cannot be seen in US economy while in China somewhere the variation in exchange rate with respect to its GDP growth was noticeable. During sub period II i.e. recessionary period in the year 1991 GDP growth of US was negative while China's GDP growth was much higher than USA in fact the differential between the two was almost 10 percent. At that time too US currency was much stronger than Chinese currency. In the year 1997-1998 booming country was again China but during first year differentials between the two countries was more but in the later year it declined consequently currency value of USA was constant whereas currency value of China depreciates. During the third recessionary period again the booming country was China but in the first year i.e. 2001 its currency value was appreciating while in next year it starts to depreciate. Similar movement we can observe in currency rate of US.

In the fourth period GDP growth of US was negative on the other hand GDP growth of China was in double digits. As we move toward the movement of their exchange rates we can see that Renminbi was appreciating in 2007 and 2008 while it depreciates in 2009 and at the same time currency value of US was constant. In the recessionary period also US currency was least affected and at the same time Chinese exchange rate shows some variations.

Table 4.8 GDP Differential of USA and China

Period	Average	Min	Max	Variance
1991	-9.36	-9.36	-9.36	0
1992-1996	-9.03	-11.12	-6.13	4.01885
1997-1998	-4.065	-4.74	-3.39	0.91125
1999-2000	-3.69	-4.4	-2.98	1.0082
2001-2002	-7.35	-7.36	-7.34	0.0002
2003-2006	-7.9125	-10.05	-6.32	2.529891667
2007-2009	-11.195	-12.45	-9.94	1.898433333
2010-2017	-5.7975	-8.11	-4.04	2.282735714

Source: Calculated by author through MS Excel

Table 4.9 Exchange rate of USA and China (RMB/USD)

Period	Average	Min	Max	Variance
1991	5.32	5.32	5.32	0
1992-1996	7.31	5.51	8.62	2.36005
1997-1998	8.28	8.28	8.29	1.120714
1999-2000	8.28	8.28	8.28	0
2001-2002	8.28	8.28	8.28	0
2003-2006	8.18	7.97	8.28	0.0214
2007-2009	7.13	6.83	7.61	0.1764
2010-2017	6.43	6.14	6.77	0.065755

Source: Calculated by author through MS Excel

The above tables compare the GDP differential and exchange rate of USA and China, productivity was all time higher in China as compared to USA. When the productivity differential was highest in 2007-2009 then too its currency value was depreciating but that was recessionary period, in normal period like in 1992-1996 and 2010-2017 productivity of China was higher then too its currency was losing its value.

4.4 Variation in Exchange Rate with Respect to Movement of Interest Rate

Generally, higher interest rate increase the value of a country's currency as higher interest rate tends to attract foreign investors increasing the demand for and value of the currency. Conversely low interest rates seems unattractive to foreign investments which will result in low value of currency. But this is not as simple as it seems, it will become complicated when it comes in contact with other factors too at the same time, for example inflation. Interest rates alone do not determine the value of currency.

The open interest parity theory talks about the effect of interest rate on the exchange rate mechanism. It says that the domestic interest rate must be higher (lower) than the foreign interest rate by an amount equal to the expected depreciation (appreciation) of the domestic currency. Dash (2004) talks about the relationship between interest rate and exchange rate in India. He argues that according to Mundell-Fleming model, an increase in interest rate is necessary to stabilize the exchange rate depreciation and to curb the inflationary pressure and thereby helps to avoid many adverse economic consequences. However, it is unlikely to accept the changes in interest rate policy to be purely exogenous to stabilize the exchange rates. But according to the asset market model of exchange rate determination when domestic interest rate rise due to an expected increase in inflation, the domestic currency depreciates.

In the figures given below broken lines denotes SDR of respective countries and normal line denotes interest rate. The comparison was divided into three sub parts firstly Indian and Chinese economy is compared, then USA and Indian economy is compared and lastly USA and Chinese economy is compared. In this trend analysis three figures have been shown to analyze the trend of the three economies.

Table 4.10 Interest Rate and Exchange Rate of China and India

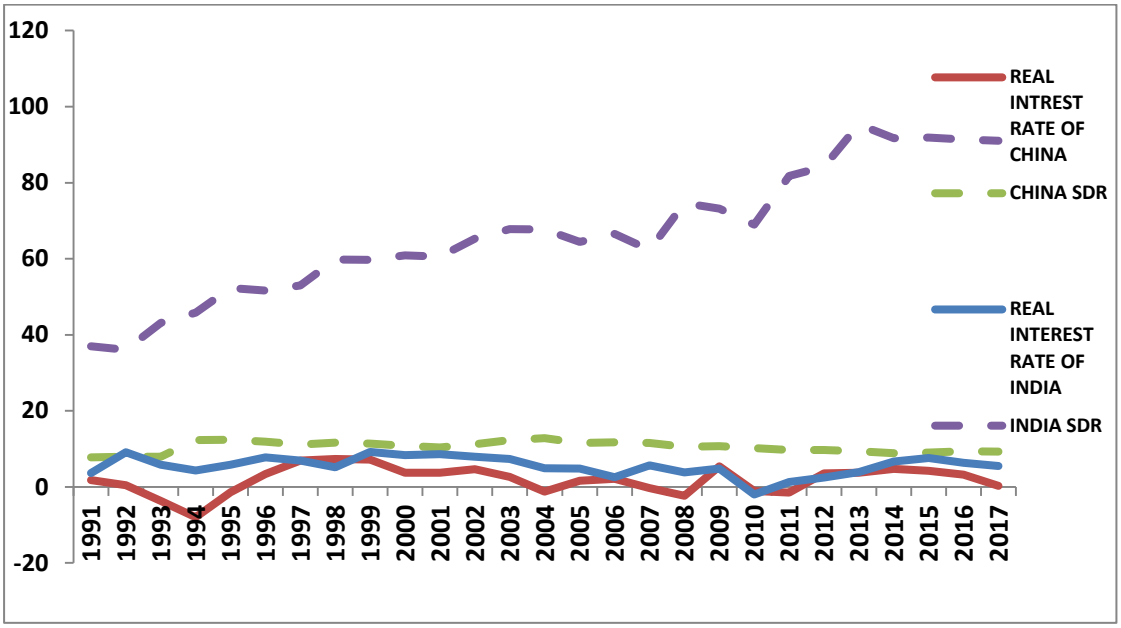
Year	Real Interest Rate of China	China SDR	Real Interest Rate of India	India SDR	Interest Rate Differential	CNY/INR
1991	1.83	7.77	3.62	36.95	-1.79	4.25
1992	0.41	7.91	9.13	36.03	-8.72	5.09
1993	-3.67	7.97	5.81	43.1	-9.48	5.41
1994	-7.98	12.33	4.34	45.81	-12.32	3.63
1995	-1.42	12.36	5.86	52.29	-7.28	3.87

1996	3.36	11.93	7.79	51.67	-4.43	4.25
1997	6.91	11.17	6.91	53	0	4.39
1998	7.35	11.66	5.12	59.81	2.23	5
1999	7.21	11.36	9.19	59.69	-1.98	5.21
2000	3.71	10.78	8.34	60.91	-4.63	5.44
2001	3.73	10.4	8.59	60.55	-4.86	5.71
2002	4.68	11.25	7.91	65.3	-3.23	5.87
2003	2.64	12.3	7.31	67.77	-4.67	5.63
2004	-1.28	12.85	4.91	67.69	-6.19	5.47
2005	1.61	11.53	4.86	64.41	-3.25	5.38
2006	2.11	11.75	2.57	66.56	-0.46	5.67
2007	-0.31	11.54	5.68	62.29	-5.99	5.41
2008	-2.33	10.53	3.77	74.63	-6.1	6.26
2009	5.45	10.7	4.81	73.18	0.64	7.07
2010	-1.06	10.2	-1.98	69.01	0.92	6.7
2011	-1.47	9.67	1.32	81.77	-2.79	7.22
2012	3.52	9.67	2.47	84.19	1.05	8.46
2013	3.69	9.4	3.87	95.32	-0.18	9.54
2014	4.73	8.87	6.7	91.75	-1.97	9.9
2015	4.25	9	7.56	91.91	-3.31	10.2
2016	3.18	9.34	6.35	91.35	-3.17	10.11
2017	0.28	9.27	5.46	91.04	-5.18	9.37

Source: World Development Indicator and International Monetary Fund

Note: Exchange Rate of China and India was unavailable on IMF so it is fetched from trading site FXTOP.com and differential is calculated through MS excel.

Figure 4.4 Trend Analyses of China and India with Respect to Real Interest Rate and SDR



The figure 4.4 compares the variation in exchange rate of India and China with respect to the movement of interest rate. In first period of sub-period I the interest rate of China was all time below than India but currency value of China was stagnant in first two year then started to depreciate which was not according to the interest parity theory. On the other hand Indian rupee loses its value except in 1992 and 1996. In second normal period the interest rate of China was lower than India, in the year 1999 currency value of India was increased and again in the next year it loses its value. On the other hand Chinese currency had been appreciating throughout the second period. In the third normal period again interest rate of India was higher than China but both the currencies losing its value in 2003 and 2006. In 2004 and 2005 currency value of India was increased while currency of China lost its value in 2004 and again recovered in 2005. During fourth normal period in the year 2010 both the interest rate were in negative nut India's rate of interest was lower than China but both the currencies were increasing its value. From the year 2011 to 2017 the interest rate of India was higher than China except in 2012 and its currency value was decreasing till 2013 and then starts to increase except in 2015. On the other hand Chinese currency increases its value all through the period except in 2015 and 2016. During the normal period we can see the variations in exchange rate of India with respect to change in interest rate many times that too for a short span of time. We can observe very few variations in exchange rate of China with the changes in its interest rate.

In the first period of sub-period II interest rate of India was higher than China but currency of China was stronger than India. In the year 1997 interest rates of both the countries were same but currency value of India decreases while currency value of China increases. In the next year of recession interest rate of China was higher than India but both the currencies lose its value. In the third period of recession interest rate of India was higher than China but the currency value of India behaves in the opposite manner as per the theory of interest parity in 2001 and acts accordingly in 2002. The change in the currency value of China was opposite to the change in India. In the fourth period of recession the interest rate of India was again higher than China except in 2009. But currency value of India appreciates in 2007 and in rest of the years it depreciates. On the other hand Chinese currency became stronger in all the years of recession except in 2009, in the same year interest rate of China rose above India.

Table 4.11 Interest rate Differential of China and India

Period	Average	Min	Max	Variance
1991	-1.79	-1.79	-1.79	0
1992-1996	-8.446	-12.32	-4.43	8.40998
1997-1998	1.115	0	2.23	2.48645
1999-2000	-3.305	-4.63	-1.98	3.51125
2001-2002	-4.045	-4.86	-3.23	1.32845
2003-2006	-3.6425	-6.19	-0.46	5.942625
2007-2009	-6.045	-6.1	0.64	14.89943
2010-2017	-1.82875	-5.18	1.05	4.961298

Source: Calculated by author through MS Excel

Table 4.12 Exchange Rates of China and India (CNY/INR)

Period	Average	Min	Max	Variance
1991	4.25	4.25	4.25	0
1992-1996	4.45	3.63	5.41	0.595
1997-1998	4.695	4.39	5	0.18605
1999-2000	5.325	5.21	5.44	0.02645
2001-2002	5.79	5.71	5.87	0.0128
2003-2006	5.5375	5.38	5.67	0.018492
2007-2009	5.835	5.41	7.07	0.689033
2010-2017	8.9375	6.7	10.2	1.804193

Source: Calculated by author through MS Excel

From the above tables we can observe the interest rate differential of India and China and exchange rate of respective countries. All the way interest rate was higher in India then too its currency was depreciating, only in 1997-1998 things were as per theory. Interest rate differentials were high in 1992- 1996 and in 2007- 2009 but Chinese Yuan was not much appreciated on the other hand in the period 2010- 2017 Chinese Yuan was appreciated from 5.8 to 8.93 when the differential was not that high i.e. -1.82.

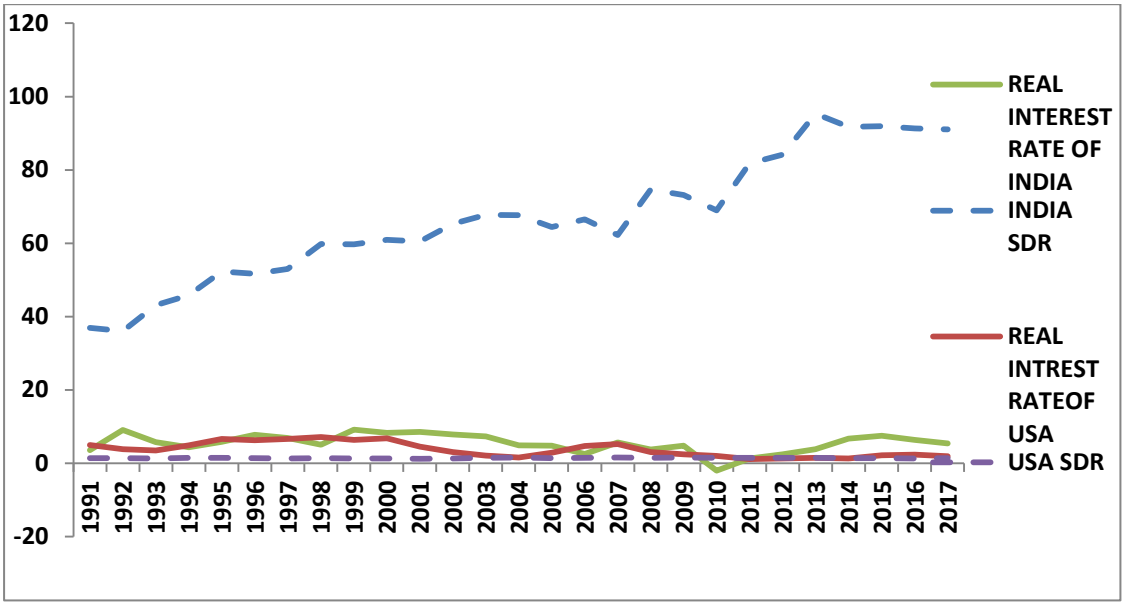
Table 4.13 Interest Rate and Exchange Rate of USA and India

Year	Real Interest Rate of USA	USA SDR	Real Interest Rate of India	India SDR	Real Interest Rate Differential	INR/USD
1991	4.97	1.43	3.62	36.95	1.35	22.74
1992	3.88	1.38	9.13	36.03	-5.25	25.92
1993	3.54	1.37	5.81	43.1	-2.27	30.49

1994	4.91	1.46	4.34	45.81	0.57	31.37
1995	6.61	1.49	5.86	52.29	0.75	32.43
1996	6.33	1.44	7.79	51.67	-1.46	35.43
1997	6.62	1.35	6.91	53	-0.29	36.31
1998	7.19	1.41	5.12	59.81	2.07	41.26
1999	6.37	1.37	9.19	59.69	-2.82	43.06
2000	6.8	1.3	8.34	60.91	-1.54	44.94
2001	4.54	1.26	8.59	60.55	-4.05	47.19
2002	3.09	1.36	7.91	65.3	-4.82	48.61
2003	2.09	1.49	7.31	67.77	-5.22	46.58
2004	1.55	1.55	4.91	67.69	-3.36	45.32
2005	2.88	1.43	4.86	64.41	-1.98	44.1
2006	4.74	1.5	2.57	66.56	2.17	45.31
2007	5.25	1.58	5.68	62.29	-0.43	41.35
2008	3.07	1.54	3.77	74.63	-0.7	43.51
2009	2.47	1.57	4.81	73.18	-2.34	48.41
2010	2	1.54	-1.98	69.01	3.98	45.73
2011	1.14	1.54	1.32	81.77	-0.18	46.67
2012	1.31	1.54	2.47	84.19	-1.16	53.44
2013	1.47	1.54	3.87	95.32	-2.4	58.6
2014	1.33	1.45	6.7	91.75	-5.37	61.03
2015	2.17	1.39	7.56	91.91	-5.39	64.15
2016	2.39	1.34	6.35	91.35	-3.96	67.2
2017	1.96	1.42	5.46	91.04	-3.5	65.12

Source: World Development Indicator and International Monetary Fund.

Figure 4.5 Trend Analyses of India and USA with Respect to Real Interest Rate and SDR



It is a comparison of developed and a developing country, as per theory once a country is developed the movement of fundamental variable does not affect its currency value and that country keep its interest rate low same is the case with USA. Currency value of US was almost stagnant no matter what changes come to its fundamental variable.

We can see from the figure 4.5 that the interest rate of US was all time lower than India except in six years i.e. 1991,1994, 1995, 1998, 2006, 2010 out of 27 years. During the first period of normal periods Indian interest rate was higher than US then too its currency value increased along with US in 1991 and 1996. In rest of the years value of Indian currency keeps on losing its value although its interest rate was lower than US in the year 1994 and 1995 but US currency was depreciating in the same years. The interest rate of India was higher than US in the year 1999 and 2000 whereas its currency value was increased during first year and then declined in the next year. On the other hand US currency was stagnant in both the years. During the period of 2003-2006 India's interest rate was lower than US only in 2006 otherwise interest rate was higher in India. On the other hand currency value of it was depreciating in 2003 and 2006 whereas US currency was depreciating all the time except in 2005. In the last normal period the interest rate of India was all time high except in 2010 while its currency was drastically appreciated in 2010 and then nominally in 2014 and 2016 in rest four periods it keeps on depreciating. On the other hand US currency was stagnant till 2013 and starts to appreciate except in 2017.

In the first recessionary period i.e. 1991 interest rate of US was higher and its currency rate was much stronger than India. In 1997 the difference between two interest rates was almost 0.3 percent but Indian currency was depreciated more than the differentials. In 1998 interest rate of USA was higher than India and both the currencies were depreciating. In the third recessionary period interest rate of India was higher than US but both the currencies were appreciating in 2001 while both lose their value in the next year. In the fourth recessionary period also interest rate of India was higher than US consequently US currency was stagnant while Indian currency depreciates only in 2008 and 2009.

Table 4.14 Interest rate differentials of USA and India

Period	Average	Min	Max	Variance
1991	1.35	1.35	1.35	0
1992-1996	-1.532	-5.25	0.75	5.99982
1997-1998	0.89	-0.29	2.07	6.541714
1999-2000	-2.18	-2.82	-1.54	0.8192
2001-2002	-4.435	-4.82	-4.05	0.29645
2003-2006	-2.0975	-5.22	2.17	9.856425
2007-2009	-0.565	-0.7	-0.43	1.068433
2010-2017	-2.2475	-5.39	3.98	9.76985

Source: Calculated by author through MS Excel

Table 4.15 Exchange rates of USA and India (INR/USD)

Period	Average	Min	Max	Variance
1991	22.74	22.74	22.74	0
1992-1996	31.12	25.92	35.43	11.94
1997-1998	38.78	36.31	41.26	12.25
1999-2000	44	43.06	44.96	1.76
2001-2002	47.9	47.19	48.61	1.008
2003-2006	45.32	44.1	46.58	1.025292
2007-2009	44.42	41.35	48.41	13.0865
2010-2017	57.74	45.73	67.2	68.84039

Source: Calculated by author through MS Excel

From the above tables we can show interest rate differential and exchange rate of India and USA, interest rate of India was all time higher than USA except in 1991 and 1997-1998 but its currency was losing its value except in 2003-2006 and 2007-2009 but interest rate differential was not that high in those years. The interest rate differential was highest in 2001- 2002 but US currency was appreciated by 3.9 rupees.

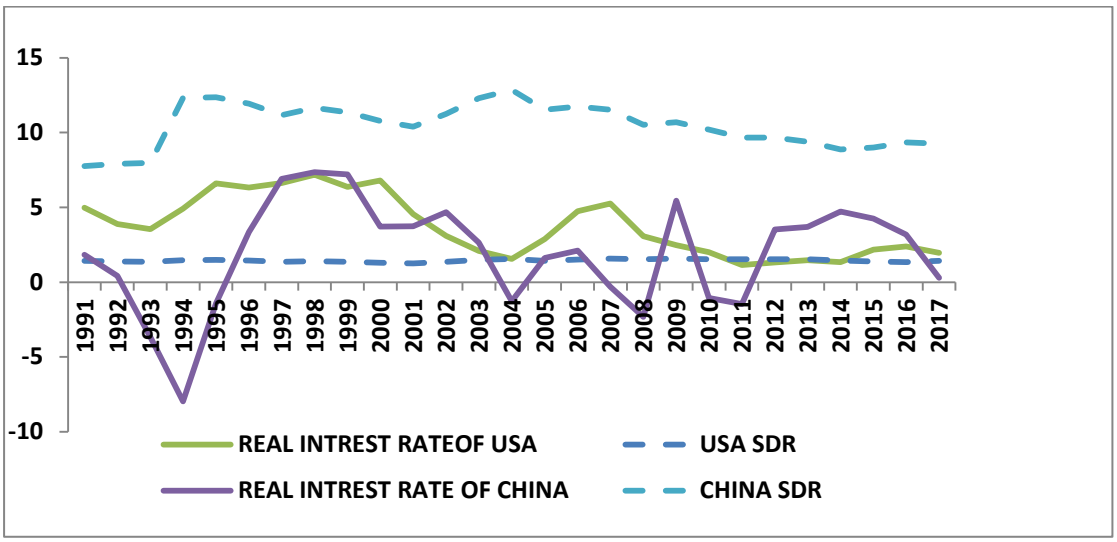
Table 4.16 Interest Rate and Exchange Rate of USA and China

Year	Real Interest Rate of USA	USA SDR	Real Interest Rate of China	China SDR	Real Interest Rate Differential	RNB/USD
1991	4.97	1.43	1.83	7.77	3.14	5.32
1992	3.88	1.38	0.41	7.91	3.47	5.51
1993	3.54	1.37	-3.67	7.97	7.21	5.76

1994	4.91	1.46	-7.98	12.33	12.89	8.62
1995	6.61	1.49	-1.42	12.36	8.03	8.35
1996	6.33	1.44	3.36	11.93	2.97	8.31
1997	6.62	1.35	6.91	11.17	-0.29	8.29
1998	7.19	1.41	7.35	11.66	-0.16	8.28
1999	6.37	1.37	7.21	11.36	-0.84	8.28
2000	6.8	1.3	3.71	10.78	3.09	8.28
2001	4.54	1.26	3.73	10.4	0.81	8.28
2002	3.09	1.36	4.68	11.25	-1.59	8.28
2003	2.09	1.49	2.64	12.3	-0.55	8.28
2004	1.55	1.55	-1.28	12.85	2.83	8.28
2005	2.88	1.43	1.61	11.53	1.27	8.19
2006	4.74	1.5	2.11	11.75	2.63	7.97
2007	5.25	1.58	-0.31	11.54	5.56	7.61
2008	3.07	1.54	-2.33	10.53	5.4	6.95
2009	2.47	1.57	5.45	10.7	-2.98	6.83
2010	2	1.54	-1.06	10.2	3.06	6.77
2011	1.14	1.54	-1.47	9.67	2.61	6.46
2012	1.31	1.54	3.52	9.67	-2.21	6.31
2013	1.47	1.54	3.69	9.4	-2.22	6.2
2014	1.33	1.45	4.73	8.87	-3.4	6.14
2015	2.17	1.39	4.25	9	-2.08	6.23
2016	2.39	1.34	3.18	9.34	-0.79	6.64
2017	1.96	1.42	0.28	9.27	1.68	6.76

Source: World Development Indicator and International Monetary Fund

Figure 4.6 Trend Analyses of China and USA with Respect to Real Interest Rate and SDR



The figure 4.6 compares China and USA variations in exchange rate with the changes in their interest rates. In the first normal period (1992-1996) interest rate of China was lower than US but its currency rate was stagnant in first two years then starts to depreciate at faster rate after 1993. On the other hand US currency rate was stagnant though its interest rate was high. In the second normal period interest rate of china was higher in 1999 and both the currency rates were appreciating at the same time. In the very next year US interest rate goes up than China and but both the currencies increasing its value. During the period 2003-2006 the interest rate of US was higher than China except in 2003 while its currency depreciates in 2003, 2004, and 2006 though its interest rate was higher than China then too its currency appreciates in 2005 and we can observe same movements in currency rate of China although the interest rate was lower than US except in 2003. In the fourth normal period interest rate of US was between 2.39-1.14 from 2010 till 2017 at the same time its interest rate was lower than China except in 2010 when China's interest rate was negative but currency value of US was stagnant till 2013 after that starts to appreciate till 2016 and again it loses its value in 2017. On the other hand Chinese currency value was increasing till 2014 and then in 2017 it again increases its value.

During recessionary periods in 1991 interest rate of US was higher than China and at the same time its currency value was also stronger. In 1997- 1998 interest rate of China was higher than US but in the first year both the currencies were appreciating and start to depreciate in next year. In 2001 US interest rate was higher but both the currency was appreciating. In next year China's interest rate was higher and accordingly its currency also depreciates but US currency was not behaving as per the theory it was also depreciating along with China. From 2007 to 2009 we can see that in 2007 and 2008 the interest rate of China was below than US and during 2009 its interest rate rose to 5.45 percent which was higher than US. Consequently, the currency rate of China was appreciating in 2007 and 2008 and depreciates in 2009 as its interest rate rose more than US but it was not according to the differentials of two interest rates. On the other hand US currency rate was stagnant. So we can say that movement in interest rate does not affect the currency rate of US whereas it somewhere affects the Chinese currency value.

Table 4.17 Interest Rate Differential of USA and China

Period	Average	Min	Max	Variance
1991	3.14	3.14	3.14	0
1992-1996	6.914	2.97	12.83	16.11564
1997-1998	-0.225	-0.29	-0.16	0.00845
1999-2000	1.125	-0.84	3.09	7.72245
2001-2002	-0.39	-1.59	0.81	2.88
2003-2006	1.545	0.55	2.83	2.431033
2007-2009	2.66	-2.98	5.56	23.8636
2010-2017	-0.4185	-3.4	3.06	6.274041

Source: Calculated by author through MS Excel

Table 4.18 Exchange rate of USA and China (RMB/USD)

Period	Average	Min	Max	Variance
1991	5.32	5.32	5.32	0
1992-1996	7.31	5.51	8.62	2.36005
1997-1998	8.28	8.28	8.29	1.120714
1999-2000	8.28	8.28	8.28	0
2001-2002	8.28	8.28	8.28	0
2003-2006	8.18	7.97	8.28	0.0214
2007-2009	7.13	6.83	7.61	0.1764
2010-2017	6.43	6.14	6.77	0.065755

Source: Calculated by author through MS Excel

From the above table we can observe the variation in exchange rate with respect to the movement of interest rate of USA and China. Out of eight sub periods, in five sub periods interest rate was higher in USA and in rest of three sub periods interest rate was higher in China. In the year 1992-1996 interest rate differential was highest and it was in favor of USA then too Chinese currency was appreciating. In 2003-2006 when interest rate was in favor of China and it was highest for China its currency was losing its value.

4.5 Variation in Exchange Rate with Respect to Movement of Inflation

There is a major impact of rate of inflation on foreign exchange rate or country's currency. However inflation is just one macro variable among various fundamental variables that affect the exchange rate of a country. It is said that inflation has a significant negative effect rather than positive effect, on a country's currency. High inflation rate or extremely high inflation rate impact the country's exchange rate with

other nations negatively. On the other hand for low inflation rate we cannot say that it will have positive effect on exchange rate. The purchasing power parity theory also states that the exchange rate between one currency and another is in equilibrium when their domestic purchasing powers at that rate of exchange are equivalent. One country's inflation rate can only be higher (lower) than another's to the extent that its exchange rate depreciates (appreciates).

In the figures given below broken lines denotes SDR of respective countries and normal line denotes inflation rate. The comparison was divided into three sub parts firstly Indian and Chinese economy is compared, then USA and Indian economy is compared and lastly USA and Chinese economy is compared. In this trend analysis three figures have been shown to analyze the trend of the three economies.

Table 4.19 Inflation and Exchange Rate of China and India

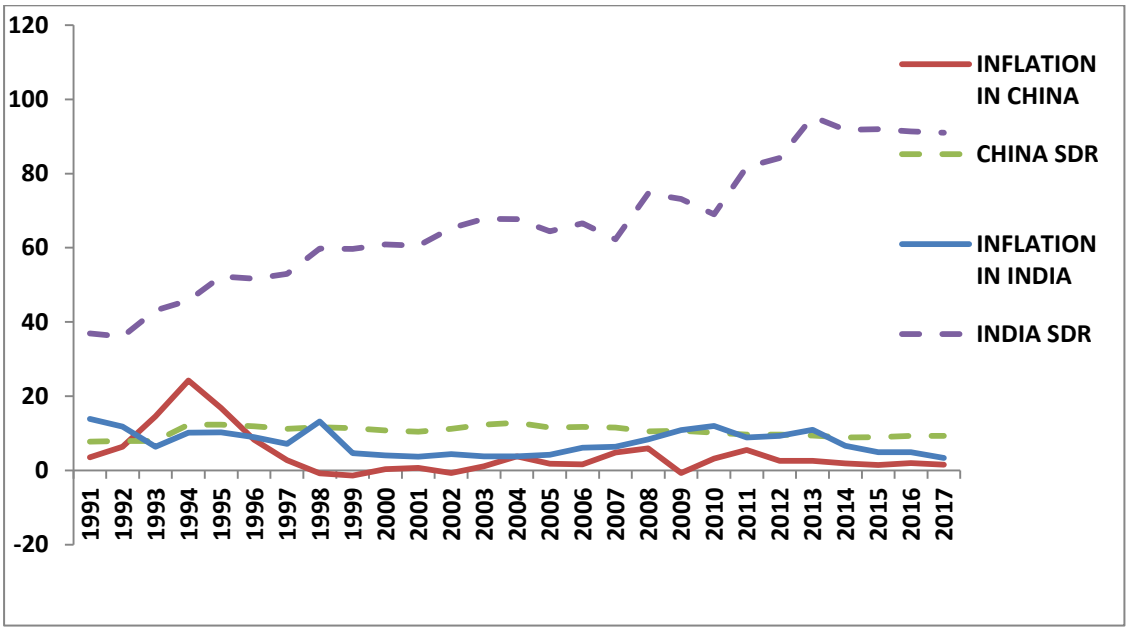
Year	Inflation in China	China SDR	Inflation in India	India SDR	Price Level Differential	CNY/INR
1991	3.56	7.77	13.87	36.95	-10.31	4.25
1992	6.35	7.91	11.79	36.03	-5.44	5.09
1993	14.61	7.97	6.36	43.1	8.25	5.41
1994	24.26	12.33	10.21	45.81	14.05	3.63
1995	16.79	12.36	10.22	52.29	6.57	3.87
1996	8.31	11.93	8.98	51.67	-0.67	4.25
1997	2.79	11.17	7.16	53	-4.37	4.39
1998	-0.77	11.66	13.23	59.81	-14	5
1999	-1.4	11.36	4.67	59.69	-6.07	5.21
2000	0.35	10.78	4.01	60.91	-3.66	5.44
2001	0.72	10.4	3.68	60.55	-2.96	5.71
2002	-0.73	11.25	4.39	65.3	-5.12	5.87
2003	1.13	12.3	3.81	67.77	-2.68	5.63
2004	3.82	12.85	3.77	67.69	0.05	5.47
2005	1.78	11.53	4.25	64.41	-2.47	5.38
2006	1.65	11.75	6.15	66.56	-4.5	5.67
2007	4.82	11.54	6.37	62.29	-1.55	5.41
2008	5.93	10.53	8.35	74.63	-2.42	6.26
2009	-0.73	10.7	10.88	73.18	-11.61	7.07
2010	3.18	10.2	11.99	69.01	-8.81	6.7
2011	5.55	9.67	8.86	81.77	-3.31	7.22
2012	2.62	9.67	9.31	84.19	-6.69	8.46
2013	2.62	9.4	10.91	95.32	-8.29	9.54

2014	1.92	8.87	6.66	91.75	-4.74	9.9
2015	1.44	9	4.91	91.91	-3.47	10.2
2016	2	9.34	4.95	91.35	-2.95	10.11
2017	1.59	9.27	3.33	91.04	-1.74	9.37

Source: World Development Indicator and International Monetary Fund

Note: Exchange Rate of China and India was unavailable on IMF so it is fetched from trading site FXTOP.com and differential is calculated through MS excel.

Figure 4.7 Trend Analyses of China and India with Respect to Inflation and SDR



The figure 4.7 compares the inflation rate of India and China and analyzes their exchange rate variation with respect to inflation. In sub period I during the year 1992-1996 inflation rate of China was higher in three years while it is below India in the year 1992 and 1996. As a result currency rate of China was stagnant in first two year and then starts to depreciate in 1994 and 1995. On the other hand Indian currency was appreciating when its inflation rate higher than China i.e. 1992 and 1996 and in rest of the years it was depreciating, in this period we can observe opposite reaction of both the currencies. In the second normal period (1999 and 2000) the inflation rate of India was higher and its currency increases its value in the first year and then depreciates in the next year while Chinese currency was increasing its value in both the years. In the third normal period inflation rate in India was higher except in 2004 accordingly its currency value also increases in the same year but currency movement was not as per

theory in the year 2005 when inflation was higher in India and its currency value was increasing. Chinese currency was losing its value in 2003, 2004, and 2006, the currency movement of China was as per theory only in 2004 and 2005. In the last normal period i.e. 2010-2017 inflation rate of India was all time higher than China then too its currency appreciates in four years and Chinese currency was depreciating in two year.

In sub period II during the year 1991 inflation rate of India was higher than China and its currency rate was also weaker than China. During the year 1997-1998 inflation rate of China was lower than India and it become negative in 1998 as a result its currency depreciates whereas currency of India losing its value as per theory of purchasing power parity. In the year 2001 the inflation rate of India was again higher than China but its currency value was increasing with China. In the consecutive year inflation rate became negative in China and it was below India but its currency was losing its value along with India. In the fourth recessionary period again inflation rate was higher in India as compared to China. The currency value of China was increasing but when its inflation rate became negative it starts to depreciate in 2009. On the other hand Indian currency loses its value in the last two year of the period.

Table 4.20 Price Level Differential of China and India

Period	Average	Min	Max	Variance
1991	10.31	10.31	10.31	0
1992-1996	4.552	-5.44	14.05	58.76722
1997-1998	-9.185	-14	-4.37	46.36845
1999-2000	-4.865	-6.07	-3.66	2.90405
2001-2002	-4.04	-5.12	-2.96	2.3328
2003-2006	-2.4	-4.5	0.05	3.4986
2007-2009	-1.985	-2.42	-1.55	31.06943
2010-2017	-5	-8.81	-1.74	6.898714

Source: Calculated by author through MS Excel

Table 4.21 Exchange Rates of China and India (CNY/INR)

Period	Average	Min	Max	Variance
1991	4.25	4.25	4.25	0
1992-1996	4.45	3.63	5.41	0.595
1997-1998	4.695	4.39	5	0.18605
1999-2000	5.325	5.21	5.44	0.02645
2001-2002	5.79	5.71	5.87	0.0128
2003-2006	5.5375	5.38	5.67	0.018492
2007-2009	5.835	5.41	7.07	0.689033
2010-2017	8.9375	6.7	10.2	1.804193

Source: Calculated by author through MS Excel

The above table compares price level differential of China and India and their exchange rates. Inflation rate of China was lower than India except from 1991 to 1996, and its currency keeps on increasing its value whether inflation was high or low. Price level differential was high 1991, 1997-1998, and 2010- 2017, in 1991 China inflation rate was higher than India but currency value was increasing that was not as per the theory, in other two periods inflation in India was higher and its currency was depreciating and its currency depreciates drastically in 2010- 2017 which was as per the theory.

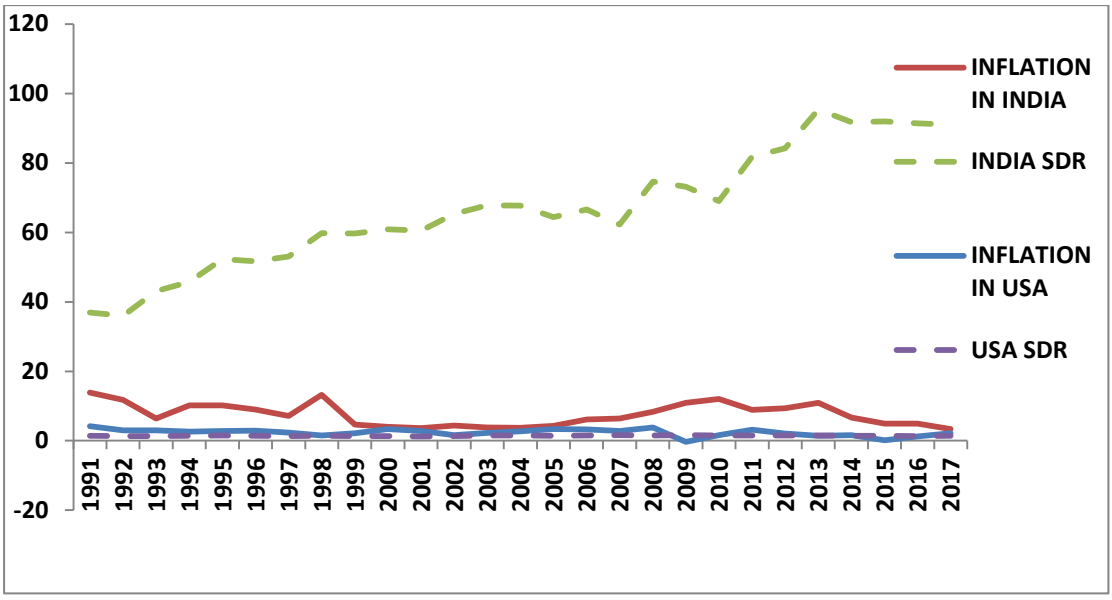
Table 4.22 Inflation and Exchange Rate of USA and India

Year	Inflation in USA	USA SDR	Inflation in India	India SDR	Price Level Differential	INR/USD
1991	4.23	1.43	13.87	36.95	-9.64	22.74
1992	3.03	1.38	11.79	36.03	-8.76	25.92
1993	2.95	1.37	6.36	43.1	-3.41	30.49
1994	2.61	1.46	10.21	45.81	-7.6	31.37
1995	2.81	1.49	10.22	52.29	-7.41	32.43
1996	2.93	1.44	8.98	51.67	-6.05	35.43
1997	2.34	1.35	7.16	53	-4.82	36.31
1998	1.55	1.41	13.23	59.81	-11.68	41.26
1999	2.19	1.37	4.67	59.69	-2.48	43.06
2000	3.38	1.3	4.01	60.91	-0.63	44.94

2001	2.83	1.26	3.68	60.55	-0.85	47.19
2002	1.59	1.36	4.39	65.3	-2.8	48.61
2003	2.27	1.49	3.81	67.77	-1.54	46.58
2004	2.68	1.55	3.77	67.69	-1.09	45.32
2005	3.39	1.43	4.25	64.41	-0.86	44.1
2006	3.23	1.5	6.15	66.56	-2.92	45.31
2007	2.85	1.58	6.37	62.29	-3.52	41.35
2008	3.84	1.54	8.35	74.63	-4.51	43.51
2009	-0.36	1.57	10.88	73.18	-11.24	48.41
2010	1.64	1.54	11.99	69.01	-10.35	45.73
2011	3.16	1.54	8.86	81.77	-5.7	46.67
2012	2.07	1.54	9.31	84.19	-7.24	53.44
2013	1.46	1.54	10.91	95.32	-9.45	58.6
2014	1.62	1.45	6.66	91.75	-5.04	61.03
2015	0.12	1.39	4.91	91.91	-4.79	64.15
2016	1.26	1.34	4.95	91.35	-3.69	67.2
2017	2.13	1.42	3.33	91.04	-1.2	65.12

Source: World Development Indicator and International Monetary Fund

Figure 4.8 Trend Analyses of USA and India with Respect to Inflation and SDR



The above figure shows the variation in exchange rate of India and USA with respect to the movement of inflation rate. During sub period I in the first normal period

inflation of India was all time higher than US but its currency rate was depreciating only in three years while it was appreciating in 1992 and 1996. On the other hand US currency rate was depreciating in 1994 and 1995. In the second normal period (1999-2000) inflation rate was again higher in India but its currency was increasing its value in 1999 while US currency rate was increasing all through the period. Inflation rate of US was lower than India but its currency value was decreasing except in 2005 during the third normal period. On the other hand India currency was appreciating in 2004 and 2005. In the last period inflation rate was higher in India but its currency value was increasing from 2011 to 2013 and 2016 to 2017. On the other hand US currency was stagnant till 2013 and then depreciates in 2017.

In sub period II in the year 1991 inflation rate was much higher in India and its currency value was also weaker than US. During 1997 and 1998 inflation rate of US economy was lower than India but its currency value decreased a bit in 1998 while Indian currency was depreciating all across this period. In the third recessionary period inflation rate of India was higher than US but its currency value increased a bit in 2001 while US currency rate was decreasing its value in 2002. In the last recessionary period US inflation rate was lower than India but its currency was losing its in 2007 and 2009 at the same time Indian currency value was increasing in the same year. So at the end of the analyses we can say that impact of inflation rate on exchange rate during recessionary period was not according to the theory of purchasing power parity in most of the years especially on US economy.

Table 4.23 Price level differential of USA and India

Period	Average	Min	Max	Variance
1991	-9.64	-9.64	-9.64	0
1992-1996	-6.646	-8.76	-3.41	4.19743
1997-1998	-8.25	-11.68	-4.82	11.6762849
1999-2000	-1.555	-2.48	-0.63	1.71125
2001-2002	-1.825	-2.8	-0.85	1.90125
2003-2006	-1.6025	-2.92	-0.86	0.851225
2007-2009	-4.015	-4.51	-3.52	17.64523333
2010-2017	-5.9325	-10.35	-1.2	9.025421429

Source: Calculated by author through MS Excel

Table 4.24 Exchange rates of USA and India (INR/USD)

Period	Average	Min	Max	Variance
1991	22.74	22.74	22.74	0
1992-1996	31.12	25.92	35.43	11.94
1997-1998	38.78	36.31	41.26	12.25
1999-2000	44	43.06	44.96	1.76
2001-2002	47.9	47.19	48.61	1.008
2003-2006	45.32	44.1	46.58	1.025292
2007-2009	44.42	41.35	48.41	13.0865
2010-2017	57.74	45.73	67.2	68.84039

Source: Calculated by author through MS Excel

From the above table we can see price level differential and exchange rates of India and USA, inflation was all time high in India so its currency depreciates according to the theory except in 2003-2006 and 2007-2009 when the inflation differential came down.

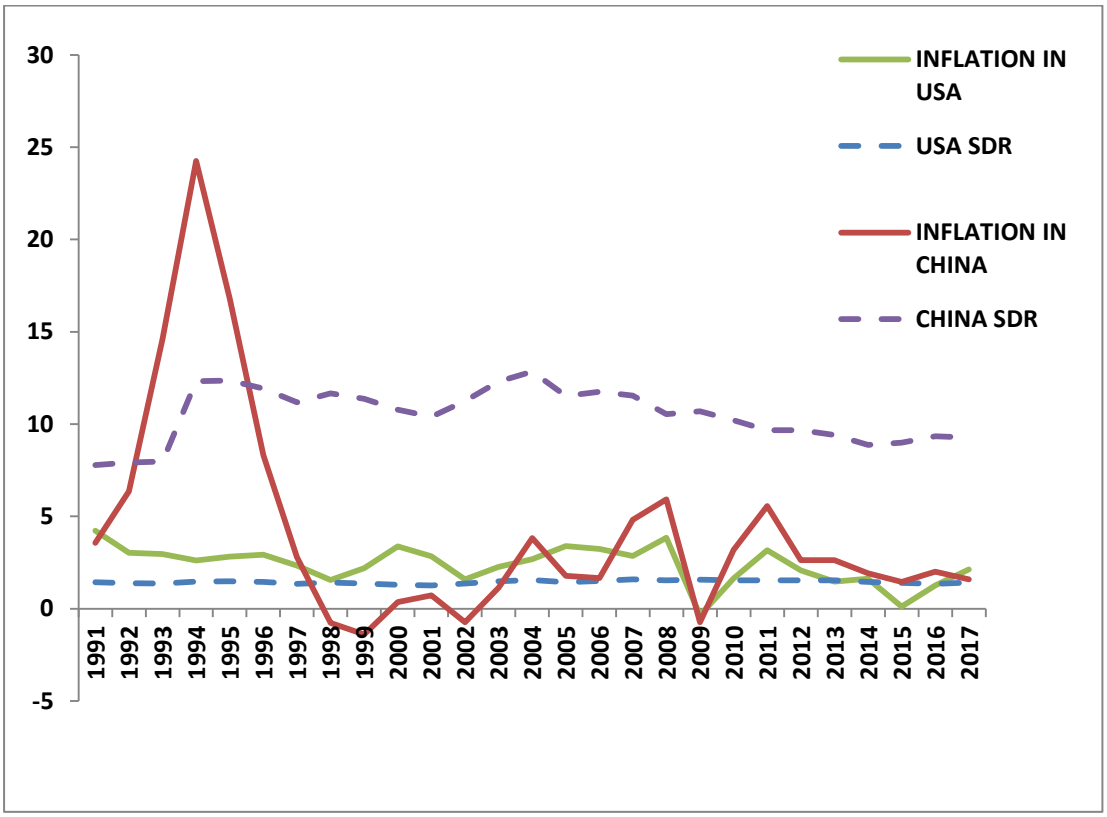
Table 4.25 Inflation and Exchange Rate of USA and China

Year	Inflation in USA	USA SDR	Inflation in China	China SDR	Price Level Differential	RNB/USD
1991	4.23	1.43	3.56	7.77	0.67	5.32
1992	3.03	1.38	6.35	7.91	-3.32	5.51
1993	2.95	1.37	14.61	7.97	-11.66	5.76
1994	2.61	1.46	24.26	12.33	-21.65	8.62
1995	2.81	1.49	16.79	12.36	-13.98	8.35
1996	2.93	1.44	8.31	11.93	-5.38	8.31
1997	2.34	1.35	2.79	11.17	-0.45	8.29
1998	1.55	1.41	-0.77	11.66	2.32	8.28
1999	2.19	1.37	-1.4	11.36	3.59	8.28
2000	3.38	1.3	0.35	10.78	3.03	8.28
2001	2.83	1.26	0.72	10.4	2.11	8.28
2002	1.59	1.36	-0.73	11.25	2.32	8.28
2003	2.27	1.49	1.13	12.3	1.14	8.28
2004	2.68	1.55	3.82	12.85	-1.14	8.28
2005	3.39	1.43	1.78	11.53	1.61	8.19
2006	3.23	1.5	1.65	11.75	1.58	7.97
2007	2.85	1.58	4.82	11.54	-1.97	7.61
2008	3.84	1.54	5.93	10.53	-2.09	6.95

2009	-0.36	1.57	-0.73	10.7	0.37	6.83
2010	1.64	1.54	3.18	10.2	-1.54	6.77
2011	3.16	1.54	5.55	9.67	-2.39	6.46
2012	2.07	1.54	2.62	9.67	-0.55	6.31
2013	1.46	1.54	2.62	9.4	-1.16	6.2
2014	1.62	1.45	1.92	8.87	-0.3	6.14
2015	0.12	1.39	1.44	9	-1.32	6.23
2016	1.26	1.34	2	9.34	-0.74	6.64
2017	2.13	1.42	1.59	9.27	0.54	6.76

Source: World Development Indicator and International Monetary Fund

Figure 4.9 Trend Analyses of USA and China with Respect to Inflation and SDR



The above figure reads the data fact of China and USA regarding the variation in exchange rate due to inflation. As the period of 27 years are subdivided into normal and recessionary period during first normal period the inflation rate of china was in double digits during 1993, 1994 and 1995 and was all time higher than US during this period consequently its currency rate was stagnant in initial two years and was appreciating in 1996. On the other hand US currency was increasing its value only in

two years i.e. 1994 and 1995. In the second normal period inflation rate was higher in USA and its currency was appreciating and similar currency movement was also in China during this period. In the third normal period the inflation rate of US was higher than China except in 2004 and both the currencies were appreciating only in 2005. In the last normal period inflation rate was high in China except in 2017 and its currency value was increasing till 2014 and again in 2017 on the other hand US currency was stagnant till 2014 and depreciates in 2017.

In the first recessionary year that is 1991 inflation was high in USA and its currency was stronger than China. During the period 1997 and 1998 currency value of China was behaving opposite in both the year, when inflation was higher than US then its currency was increasing its value and when it became negative and lower than US then its currency depreciates. On the other hand currency movement of US was as per the theory. In the third recessionary period inflation was high in US but both currencies appreciate in 2001 and next year both depreciate. In the last recessionary period i.e. 2007- 2009 the inflation was higher in China in the two initial years of the period and inflation rate of both the countries became negative in 2009 but high in US. As a result currency rate of China was increasing its value in first two years and in the year 2009 it loses its value. On the other hand US currency was almost stagnant.

Table 4.26 Price level Differential of USA and China

Period	Average	Min	Max	Variance
1991	0.67	0.67	0.67	0
1992-1996	-11.198	-21.65	-3.32	53.27732
1997-1998	0.935	-0.45	2.32	3.83645
1999-2000	3.31	3.03	3.59	0.1568
2001-2002	2.215	2.11	2.32	0.02205
2003-2006	0.7975	-1.14	1.61	1.714558333
2007-2009	-2.03	-2.09	0.37	1.9236
2010-2017	-0.9325	-2.39	0.54	0.778135714

Source: Calculated by author through MS Excel

Table 4.27 Exchange rate of USA and China (RMB/USD)

Period	Average	Min	Max	Variance
1991	5.32	5.32	5.32	0
1992-1996	7.31	5.51	8.62	2.36005
1997-1998	8.28	8.28	8.29	1.120714
1999-2000	8.28	8.28	8.28	0
2001-2002	8.28	8.28	8.28	0
2003-2006	8.18	7.97	8.28	0.0214
2007-2009	7.13	6.83	7.61	0.1764
2010-2017	6.43	6.14	6.77	0.065755

Source: Calculated by author through MS Excel

From the above table we can see in the sub period 1992-1996 inflation was very high in China but its currency was increasing its value. Secondly when inflation was highest in USA during 1999-2000 then currency value was constant neither it was increasing nor it was decreasing.

4.6 Variation in Exchange Rate with Respect to Movement of Current Account Balance

When a country sells more goods and services to overseas markets than it buys from them, then it has a trade surplus. A trade surplus increases the value of the currency because it brings in more foreign currency into India than the amount of currency that is paid for imports. The balance of payment approach says current account surplus decrease the interest rate and corrects imbalance on the other hand increases the interest rate as a result it removes the current account deficit or corrects the imbalance in balance of payment. To offset current account balance capital must flow in, similarly to remove surplus in current account balance capital must flow out. So CAB determines exchange rate in short run because it is a part of money market and money market determines exchange rate at a faster speed so it determine exchange rate in short run.

Table 4.28 Current Account Balance and Exchange Rate of China and India

Year	CAB as % of GDP of China	China SDR	CAB as % of GDP of India	India SDR	Export/Import Differential	CNY/INR
1991	3.46	7.77	-1.59	36.95	5.05	4.25
1992	1.5	7.91	-1.56	36.03	3.06	5.09
1993	-2.61	7.97	-0.67	43.1	-1.94	5.41
1994	1.22	12.33	-0.51	45.81	1.73	3.63
1995	0.22	12.36	-1.54	52.29	1.76	3.87
1996	0.84	11.93	-1.52	51.67	2.36	4.25
1997	3.84	11.17	-0.71	53	4.55	4.39
1998	3.06	11.66	-1.64	59.81	4.7	5
1999	1.93	11.36	-0.7	59.69	2.63	5.21
2000	1.69	10.78	-0.98	60.91	2.67	5.44
2001	1.3	10.4	0.29	60.55	1.01	5.71
2002	2.41	11.25	1.37	65.3	1.04	5.87
2003	2.59	12.3	1.44	67.77	1.15	5.63
2004	3.53	12.85	0.11	67.69	3.42	5.47
2005	5.79	11.53	-1.25	64.41	7.04	5.38
2006	8.42	11.75	-0.99	66.56	9.41	5.67
2007	9.94	11.54	-0.66	62.29	10.6	5.41
2008	9.15	10.53	-2.58	74.63	11.73	6.26
2009	4.76	10.7	-1.95	73.18	6.71	7.07
2010	3.9	10.2	-3.25	69.01	7.15	6.7
2011	1.8	9.67	-3.43	81.77	5.23	7.22
2012	2.52	9.67	-5	84.19	7.52	8.46
2013	1.54	9.4	-2.65	95.32	4.19	9.54
2014	2.25	8.87	-1.34	91.75	3.59	9.9
2015	2.75	9	-1.07	91.91	3.82	10.2
2016	1.81	9.34	-0.53	91.35	2.34	10.11
2017	1.35	9.27	-1.44	91.04	2.79	9.37

Source: World Development Indicator and International Monetary Fund

Note: Exchange Rate of China and India was unavailable on IMF so it is fetched from trading site FXTOP.com and differential is calculated through MS excel.

Figure 4.10 Trend Analysis of Variation in Exchange Rate with Respect to Current Account Balance in India and China

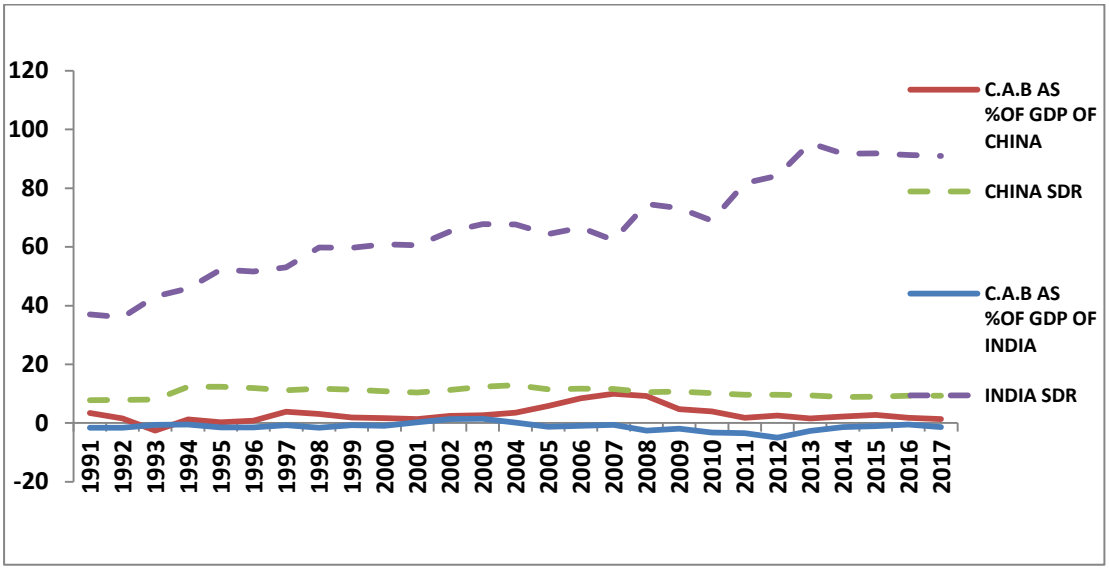


Table 4.29 Cab differential of China and India

Period	Average	Min	Max	Variance
1991	5.05	5.05	5.05	0
1992-1996	1.394	-1.94	3.06	3.76778
1997-1998	4.625	4.55	4.7	0.01125
1999-2000	2.65	2.63	2.67	0.0008
2001-2002	1.025	1.01	1.04	0.00045
2003-2006	5.255	1.15	9.41	13.55616667
2007-2009	11.165	10.6	11.73	6.9349
2010-2017	4.57875	2.34	7.52	3.657498214

Source: Calculated by author through MS Excel

Table 4.30 Exchange Rate of China and India (CNY/INR)

Period	Average	Min	Max	Variance
1991	4.25	4.25	4.25	0
1992-1996	4.45	3.63	5.41	0.595
1997-1998	4.695	4.39	5	0.18605
1999-2000	5.325	5.21	5.44	0.02645
2001-2002	5.79	5.71	5.87	0.0128
2003-2006	5.5375	5.38	5.67	0.018492
2007-2009	5.835	5.41	7.07	0.689033
2010-2017	8.9375	6.7	10.2	1.804193

Source: Calculated by author through MS Excel

The above tables show the import and export differential of China and India and their exchange rate, Chinese economy is always a surplus economy whereas Indian economy is a deficit one, mostly its imports exceed its export. From the above table we can observe that the differential of the economy was highest in 2007- 2009 and its currency value appreciates drastically in the next period i.e. 8.93.

Table 4.31 Current Account Balance and Exchange Rate of USA and India

Year	CAB as % of GDP of USA	USA SDR	CAB as % of GDP of India	India SDR	Export/Import Differential	INR/USD
1991	0.05	1.43	-1.59	36.95	1.64	22.74
1992	-0.79	1.38	-1.56	36.03	0.77	25.92
1993	-1.23	1.37	-0.67	43.1	-0.56	30.49
1994	-1.66	1.46	-0.51	45.81	-1.15	31.37
1995	-1.48	1.49	-1.54	52.29	0.06	32.43
1996	-1.54	1.44	-1.52	51.67	-0.02	35.43
1997	-1.63	1.35	-0.71	53	-0.92	36.31
1998	-2.37	1.41	-1.64	59.81	-0.73	41.26
1999	-2.98	1.37	-0.7	59.69	-2.28	43.06
2000	-3.92	1.3	-0.98	60.91	-2.94	44.94
2001	-3.67	1.26	0.29	60.55	-3.96	47.19
2002	-4.11	1.36	1.37	65.3	-5.48	48.61
2003	-4.51	1.49	1.44	67.77	-5.95	46.58
2004	-5.15	1.55	0.11	67.69	-5.26	45.32
2005	-5.69	1.43	-1.25	64.41	-4.44	44.1
2006	-5.82	1.5	-0.99	66.56	-4.83	45.31
2007	-4.91	1.58	-0.66	62.29	-4.25	41.35
2008	-4.63	1.54	-2.58	74.63	-2.05	43.51
2009	-2.58	1.57	-1.95	73.18	-0.63	48.41
2010	-2.88	1.54	-3.25	69.01	0.37	45.73
2011	-2.87	1.54	-3.43	81.77	0.56	46.67
2012	-2.64	1.54	-5	84.19	2.36	53.44
2013	-2.08	1.54	-2.65	95.32	0.57	58.6
2014	-2.08	1.45	-1.34	91.75	-0.74	61.03
2015	-2.24	1.39	-1.07	91.91	-1.17	64.15
2016	-2.31	1.34	-0.53	91.35	-1.78	67.2
2017	-2.3	1.42	-1.44	91.04	-0.86	65.12

Source: World Development Indicator and International Monetary Fund

Figure 4.11 Trend Analysis of Variation in Exchange Rate with Respect to the Movement of Current Account Balance in India and USA

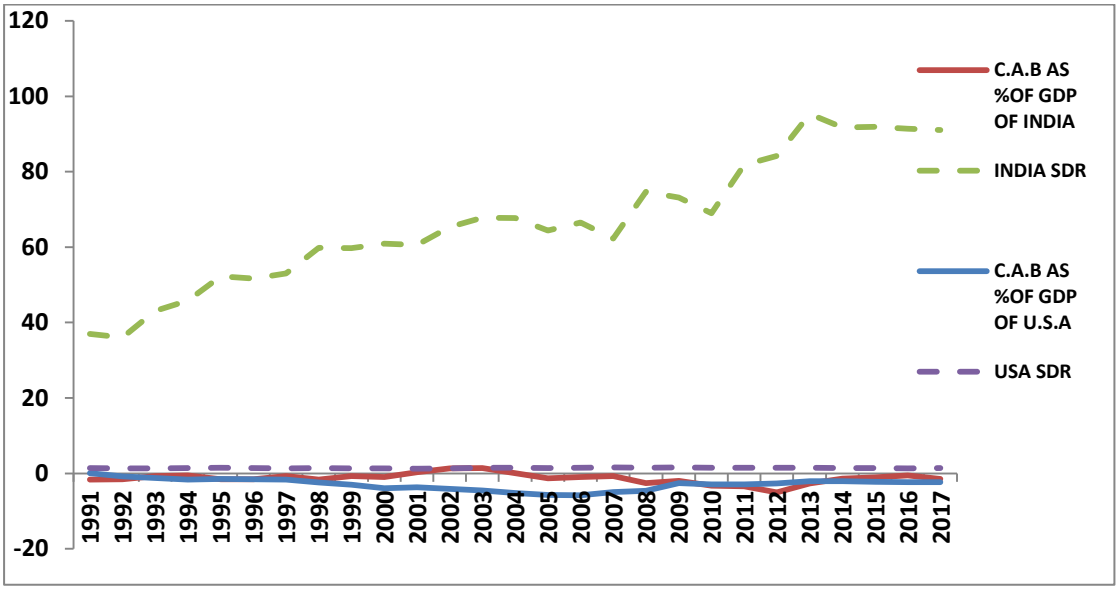


Table 4.32 CAB differential of USA and India

Period	Average	Min	Max	Variance
1991	1.64	1.64	1.64	0
1992-1996	-0.18	-1.15	0.77	0.51775
1997-1998	-0.825	-0.92	-0.73	5.237219943
1999-2000	-2.61	-2.94	-2.28	0.2178
2001-2002	-4.72	-5.48	-3.96	1.1552
2003-2006	-5.12	-5.95	-4.44	0.418333333
2007-2009	-3.15	-4.25	-0.63	3.3268
2010-2017	-0.08625	-1.78	2.36	1.729998214

Source: Calculated by author through MS Excel

Table 4.33 Exchange rates of USA and India (INR/USD)

Period	Average	Min	Max	Variance
1991	22.74	22.74	22.74	0
1992-1996	31.12	25.92	35.43	11.94
1997-1998	38.78	36.31	41.26	12.25
1999-2000	44	43.06	44.96	1.76
2001-2002	47.9	47.19	48.61	1.008
2003-2006	45.32	44.1	46.58	1.025292
2007-2009	44.42	41.35	48.41	13.0865
2010-2017	57.74	45.73	67.2	68.84039

Source: Calculated by author through MS Excel

The above tables observe the CAB differential of India and USA showed least variations while their exchange rates are showing high variations especially in 2010-2017 i.e. 68.84. USA deficit was all time higher than India but its currency was increasing its value except in 2003-2006 and 2007-2009 when current account deficit of USA was very high.

Table 4.34 Current Account Balance and Exchange Rate of USA and China

Year	CAB as % of GDP of USA	USA SDR	CAB as % of GDP of China	China SDR	Export/Import Differential	RNB/USD
1991	0.05	1.43	3.46	7.77	-3.41	5.32
1992	-0.79	1.38	1.5	7.91	-2.29	5.51
1993	-1.23	1.37	-2.61	7.97	1.38	5.76
1994	-1.66	1.46	1.22	12.33	-2.88	8.62
1995	-1.48	1.49	0.22	12.36	-1.7	8.35
1996	-1.54	1.44	0.84	11.93	-2.38	8.31
1997	-1.63	1.35	3.84	11.17	-5.47	8.29
1998	-2.37	1.41	3.06	11.66	-5.43	8.28
1999	-2.98	1.37	1.93	11.36	-4.91	8.28
2000	-3.92	1.3	1.69	10.78	-5.61	8.28
2001	-3.67	1.26	1.3	10.4	-4.97	8.28
2002	-4.11	1.36	2.41	11.25	-6.52	8.28
2003	-4.51	1.49	2.59	12.3	-7.1	8.28
2004	-5.15	1.55	3.53	12.85	-8.68	8.28
2005	-5.69	1.43	5.79	11.53	-11.48	8.19
2006	-5.82	1.5	8.42	11.75	-14.24	7.97
2007	-4.91	1.58	9.94	11.54	-14.85	7.61
2008	-4.63	1.54	9.15	10.53	-13.78	6.95
2009	-2.58	1.57	4.76	10.7	-7.34	6.83
2010	-2.88	1.54	3.9	10.2	-6.78	6.77
2011	-2.87	1.54	1.8	9.67	-4.67	6.46
2012	-2.64	1.54	2.52	9.67	-5.16	6.31
2013	-2.08	1.54	1.54	9.4	-3.62	6.2
2014	-2.08	1.45	2.25	8.87	-4.33	6.14
2015	-2.24	1.39	2.75	9	-4.99	6.23
2016	-2.31	1.34	1.81	9.34	-4.12	6.64
2017	-2.3	1.42	1.35	9.27	-3.65	6.76

Source: World Development Indicator and International Monetary Fund

Figure 4.12 Trend Analysis of Variation in Exchange Rate with Respect to the Movement of Current Account Balance in USA and China

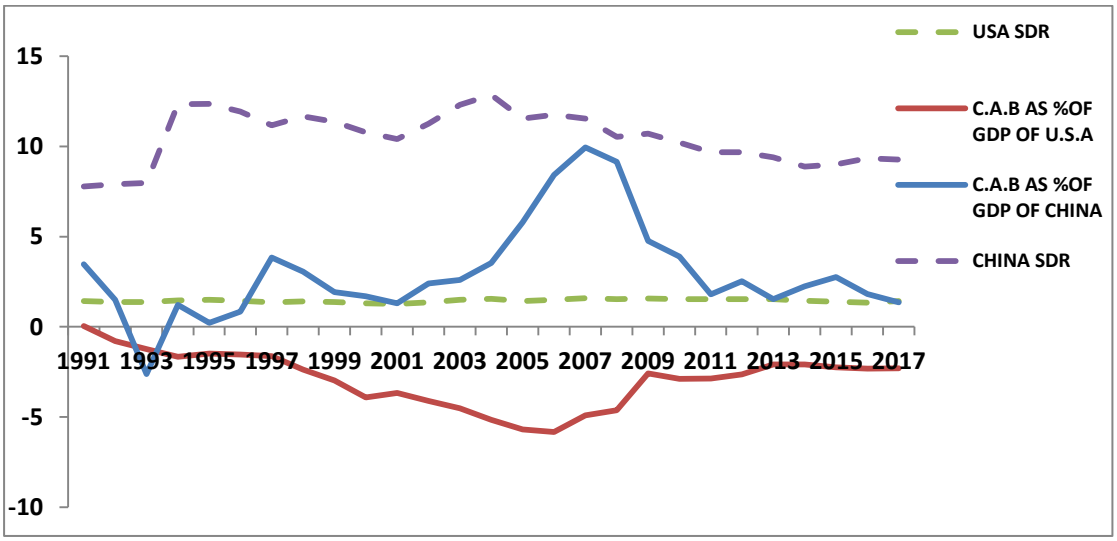


Table 4.35 CAB Differential of USA and China

Period	Average	Min	Max	Variance
1991	-3.41	-3.41	-3.41	0
1992-1996	-1.574	-2.88	1.38	2.90248
1997-1998	-5.45	-5.47	-5.43	0.0008
1999-2000	-5.26	-5.61	-4.91	0.245
2001-2002	-5.745	-6.52	-4.97	1.20125
2003-2006	-10.375	-14.24	-7.1	9.9193
2007-2009	-14.315	-14.85	-7.34	16.5031
2010-2017	-4.665	-6.78	-3.62	1.050771429

Source: Calculated by author through MS Excel

Table 4.36 Exchange rate of USA and China (RMB/USD)

Period	Average	Min	Max	Variance
1991	5.32	5.32	5.32	0
1992-1996	7.31	5.51	8.62	2.36005
1997-1998	8.28	8.28	8.29	1.120714
1999-2000	8.28	8.28	8.28	0
2001-2002	8.28	8.28	8.28	0
2003-2006	8.18	7.97	8.28	0.0214
2007-2009	7.13	6.83	7.61	0.1764
2010-2017	6.43	6.14	6.77	0.065755

Source: Calculated by author through MS Excel

As we all know that Chinese economy is a surplus economy and US economy is a deficit economy, but the variance in exchange rate of both the economies is almost nil after 1998 while we can notice the variation in CAB of both the economies after 1998.

The highest variance value of cab of both the countries was in 2007-2009 and then in 2003-2006.

4.7 Conclusions

Various studies and journal already tells us the relationship of variable with exchange rate and which variable determines the exchange rate of a country. On the contrary GDP growth and inflation determines the exchange rate in the long run whereas CAB and interest rate determines the exchange rate in the short run as it is a part of money market and money market respond faster than goods market. From the basic statistical tools used in analyzing the variation, we can conclude that there are movements in fundamental variables of India and China while we cannot observe much variation with respect to the movement of fundamental variables of USA. When we compare the productivity differential, interest rate differentials, price level differentials, CAB differentials of India and China we can observe that the variance value of all four differentials are moving up and down with the time but we cannot register much variance in their exchange rate. Similarly, we compared India and USA all the four differentials were varying with time but exchange rate of both the countries was showing high variance in their exchange rate especially during 2010-2017. And the movements of exchange rate between these two countries are much higher than the movement of their fundamental variable. At the same time we can also observe the same thing in the trend analysis too India's SDR was high while USA's SDR was constant though their fundamental variables were moving, things were not as per theory. As per theory of determination of exchange rate Indian Rupee should appreciate as the movement of its fundamental variable was in favor of appreciation, while USD should depreciate as its fundamental variable was against appreciation. Lastly we compared China and USA, from the trend analysis we can notice that USA's SDR was constant while China's SDR was moving up and down with the time but the movement was very slight. Now when we talk of their fundamental variables, its movement says that China's currency should be appreciated and USA's currency should be depreciated but scenario is just opposite to the theory. With respect to the basic statistical tool we can analyze that the four differentials variations were high but we cannot register much variation in their exchange rates, even its variance value was 0 from 1999- 2006.

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CHAPTER 5

Pattern of Misalignment between Performance of Fundamental Variables and Exchange Rate Determination

5.1 Introduction

The growing interaction in markets between countries all over the world has made the idea of globalization increasingly trending in recent years. The developed nations favored for globalization to get benefits from widening size of the market for their products; locating and speeding optimally capital investment across different countries. For developing countries like India globalization carries benefits and opportunities as well as costs and risks. Both India and China have been recently using globalization as an opportunity to accelerate the economic growth so as to catch up with developed nations. The foreign exchange market is much affected by globalization, as it determines the competitiveness of goods and services in global markets and affects currency value too. When currency value is overvalued or undervalued and not in line with fundamentals it is considered as currency misalignment.

Currency misalignment is an area of interest since long, there are many research papers and studies are available which proves the fact. Some studies says that it is related to under valuation and over valuation of currencies, while some correlates it with the movement of fundamental variable and micro variables. China is considered the best example for currency misalignment, as it is an emerging economy in matter of economic growth but its currency has been devalued since long.

In this study currency misalignment defines whether the exchange rate follows the movement of fundamental variable or not. If exchange rate follows the movement of fundamental variables then there is no currency misalignment and if it not then currency misalignment exists. Basically it is said that the factors influencing exchange rate differs in short run and long run. Many study investigated that fundamental variables influences exchange rate in long run on the other hand some argues that in long run currency misalignment corrects itself and said the movement of fundamental variables influences the exchange rate only in short run. According to Stein Masunda movements in real exchange rate should be in line with real fundamentals and if it has persistently wandered away from the long run equilibrium exchange rate then it will be misaligned.

Exchange rate misalignment acts as indicators on how the exchange rate will have to gravitate in a freely floating exchange rate regime and how authorities need to revalue

(devalue) their exchange rate in countries employing the fixed exchange rate system. Exchange rate misalignment is argued to be an important determinant of economic growth. Over valuation presumed to hurt growth whereas the correlation between undervaluation and growth is weak.

5.1.2 Role of Special Drawing Right (SDR)

The SDR was created as a supplementary international reserve asset in the context of the Bretton Woods fixed exchange rate system. The collapse of Bretton Woods system in 1973 and the shift of the major currencies to floating exchange rate regimes lessened the reliance on the SDR as a global reserve asset. Nonetheless, SDR allocations can play role in providing liquidity and supplementing member countries' official reserves, as was the case with the 2009 allocations totaling SDR 182.6 billion to IMF members amid the global financial crisis.

SDR serves as unit of account of the IMF and some other international organizations. The SDR is neither a currency nor a claim on the IMF. Rather, it is a potential claim on the freely usable currencies of IMF members. The table below shows the basket of currencies of SDR and its weights determined in the 2015 review. In this analysis SDR is the base of exchange rate as we are comparing US also so we cannot take USD as a base of exchange rate**.**

Table 5.1 Currencies of SDR and Its Weights

Currency	Weights determined in 2015
U. S. Dollar	41.73
Euro	30.93
Chinese Yuan	10.92
Japanese Yen	8.33
Pound Sterling	8.09

Source: IMF Exchange Rates, Daily Updates

5.1.2 Determination of Exchange Rates

It is foreign exchange market where exchange rate among different currencies is determined. At present India and USA follows floating or flexible exchange rate regime while China follows pegged exchange rate regime from 1993 onwards, earlier China

was following fixed exchange rate regime i.e. fixed by the government till 1993 and then they pegged their currency against dollar till 2015 they pegged their currency against various currencies. The exchange rate regime of USA is totally market driven while India follows managed exchange rate regime that means RBI intervenes in foreign exchange market to influence the exchange rate of rupee.

Table 5.2 Factors of Exchange Rate and its Affect on Currency Value

Factors	**Change in Factors**	**Response of currency value**
Domestic interest rate	↑	↑
Foreign interest rate	↑	↓
Expected domestic price level *	↑	↓
Expected import demand	↑	↓
Expected export demand	↑	↑
Expected productivity *	↑	↑

*Relative to other countries

Note: Only increases in the factors are shown; the effects of decreases in the variables on the exchange rate the opposite of those indicated in the "Response" column

Source: *The economics of money, banking, and financial market*, Mishkin, F. S.

Earlier in chapter four I already discussed the variations in exchange rate of three economies viz. India, China and USA with respect to the movement of their fundamental variables through trend analysis. This work has been started with seven fundamental variables that are GDP growth, interest rate, inflation, domestic savings, investment, employment and current account balance. According to the theory only four variables affect the exchange rate i.e. GDP growth, interest rate, inflation and CAB rest of the variable affects the exchange rate indirectly. As per trend analysis we can see that India show some variations in exchange rate with respect to the movement of its

fundamental variables and sometimes it is as per theory and sometimes it is not, while China and USA hardly show any variations in exchange rate with respect to the movement of their fundamental variables which is not as per the theory. From the trend analysis we can also see that fundamental variable of China was performing very well whereas performance of fundamental variable in USA was worst. But when we talk of currency, US currency is strongest whereas currency of India is weakest among all the three currencies. In trend analysis itself we can see that there is some kind of artificial intervention in the determination of exchange rate. Therefore, there is a need to answer empirically the question such as what is the impact of fundamental variables on exchange rate of the respective countries viz. India, China and USA and is there any currency misalignment among these three economies? Whether and how far the exchange rate depreciates or appreciates due to an changes in fundamental variables? We attempt to answer these questions through this study.

This chapter will analyze the pattern of currency misalignment of India, China and USA. In this chapter first I will perform unit root test to analyze the stationarity of the data. After that we will apply fixed effect LSDV model. For the empirical tests we will use four models for four different variables i.e. GDP growth, interest rate, inflation and current account balance and will introduce dummies accordingly because if we regress all the variable in one model we have to introduce lots of dummies and that can create problem in the result.

5.2 Models

We base this empirical study on the pattern of misalignment in India, China and USA. The main question of this chapter is whether and how far exchange rate appreciates or depreciates with the increase and decrease of GDP growth, interest rate, inflation and current account balance of the respective country.

5.2.1 Variables

For our analysis we identify four independent variables as follows:

- Inflation rate: The purchasing power parity theory says the exchange rate between one currency and another is in equilibrium when their domestic purchasing powers are equal at that exchange rate. The inflation rate of a

country can only be higher or lower than other country to the extent that its exchange rate depreciates/appreciates.

- Interest rate: Another important factor for movement in exchange rate in recent years has been differences in interest rate between trading countries. The open interest parity theory says that the domestic interest rate must be higher/lower than foreign interest rate by an amount equal to the expected depreciation/appreciation of the domestic currency.
- GDP growth: Generally booming economies always lift the value of currency, if there is no government intervention. At the same time during recession economy will always lead to lose the value of currency.
- Trade balance: Trade balance is another factor that determines the exchange rate. If a country is a surplus economy it will lead to appreciate its currency whereas deficit economies always lead to depreciate the currency.

Here the dependent variable is SDR.

5.2.3 Data sources

We consider annual data for the four independent variables mentioned above for a period of 27 years (1991-2017). Also, data for the dependent variable is considered for the same period. We obtained the data from various sources like World Bank Development Index, IMF's e-library data etc.

5.3 Tests

Since the data we have is panel data, we first check the unit root problem in all the variables. For this, we apply Hadri LM unit root test on each variable to check whether each of these variables is stationary or not.

Hypothesis of Hadri LM test:

$H_{0:}$ All panels are stationary.

$H_{1:}$ Panel contains unit root

Now we use fixed effect LSDV model to be estimated as follows:

$$ER = f\ (GDP\ growth, Interest\ Rate, Inflation, CAB)$$

Model 1

For tracing the currency misalignment with respect to GDP we define the model to be estimated as follows:

$$\mathrm{ER} = \beta 0 + \beta 1\mathrm{GDP} + \beta 2\mathrm{D2} + \beta 3\mathrm{D3} + \mathrm{B4GDPD2} + \beta 5\mathrm{GDPD3} + \mathrm{ui} \ldots\ldots (1)$$

Where

ER = Exchange Rate

β_0 = Intercept

β_1GDP = GDP of reference country {Reference country is India}

$\beta_2 D_2$ = Dummy variable {Dichotomous; 1= China, 0= others}

$\beta_3 D_3$ = Dummy variable {Dichotomous; 1= USA, 0= others}

$\beta_4 GDPD_2$ = GDP of D_2

$\beta_5 GDPD_3$ = GDP of D_3

Hypothesis:

H_0: Exchange rates do not follow GDP growth.

H_1: Exchange rates follow GDP growth.

Model 2

For tracing the currency misalignment with respect to interest rate we use the model to be estimated as follows:

$$ER = \beta 0 + \beta 1Int + \beta 2D2 + \beta 3D3 + B4IntD2 + \beta 5IntD3 + ui \ldots\ldots\ldots (2)$$

Where

ER = Exchange Rate

β_0 = Intercept

β_1Int = Interest rate of reference country {Reference country is India}

β_2D_2 = Dummy variable {Dichotomous; 1= China, 0= others}

β_3D_3 = Dummy variable {Dichotomous; 1= USA, 0= others}

β_4IntD_2 = Interest rate of D_2

β_5IntD_3 = Interest rate D_3

Hypothesis:

H_0: Exchange rates do not follow interest rate.

H_1: Exchange rate follows the interest rate.

Model 3

For tracing the currency misalignment with respect to inflation we use the model to be estimated as follows:

$$ER = \beta 0 + \beta 1Inf + \beta 2D2 + \beta 3D3 + B4InfD2 + \beta 5InfD3 + ui \dots\dots\dots (3)$$

Where

ER = Exchange Rate

β_0 = Intercept

β_1Inf = Inflation in reference country {Reference country is India}

β_2D_2 = Dummy variable {Dichotomous; 1= China, 0= others}

β_3D_3 = Dummy variable {Dichotomous; 1= USA, 0= others}

β_4InfD_2 = Inflation in D_2

β_5InfD_3 = Inflation in D_3

Hypothesis:

H_0: Exchange rates do not follow inflation.

H_1: Exchange rates follow inflation.

Model 4

For tracing the currency misalignment with respect to current account balance we use the model to be estimated as follows:

$$ER = \beta 0 + \beta 1Cab + \beta 2D2 + \beta 3D3 + B4CabD2 + \beta 5CabD3 + ui \dots\dots\dots (4)$$

Where

ER = Exchange Rate

β_0 = Intercept

$\beta_1$cab = Current account balance of reference country {Reference country is India}

$\beta_2 D_2$ = Dummy variable {Dichotomous; 1= China, 0= others}

$\beta_3 D_3$ = Dummy variable {Dichotomous; 1= USA, 0= others}

$\beta_4 cabD_2$ = Current account balance of D_2

$\beta_5 cabD_3$ = Current account balance D_3

Hypothesis:

H_0: Exchange rates do not follow current account balance.

H_1: Exchange rates follow current account balance.

5.4 Observation and Results

5.4.1 Unit Root Test

Table 5.3 Stationarity Test of Independent Variable

Variable	Data at level (p value)	Data at first difference (p value)
GDP growth	0.0000	0.8496
Interest Rate	0.0000	0.9154
Inflation Rate	0.0000	0.8663
Current Account Balance	0.0000	0.6988

Source: Calculated by author using Hadri LM unit root test through Stata software

From the above table it is clear that our data is stationary at first difference because the p value at first difference is supporting to accept null hypothesis of Hadri LM unit tests i.e. all panels are stationary while when data is at level p value supported to reject null hypothesis and it shows that panel contains unit root problem. Data at first difference are of same order, so we can use the original data as per the theory of co integration.

5.4.2 Pattern of currency misalignment with respect to GDP

Table 5.4 Regression Result of GDP Growth

Model	Un standardized Coefficients		Standardized Coefficients	T	Significance
	B	Std. Error	Beta	B	Std. Error
(Constant)	50.787	6.006		8.457	.000
GDP	2.381	.861	.283	2.766	.007
D2	-41.242	10.247	-.639	-4.025	.000
D3	-49.296	6.869	-.764	-7.177	.000
GDPD2	-2.283	1.196	-.358	-1.909	.060
GDPD3	-2.400	1.427	-.117	-1.682	.097

Dependent Variable: ER Source: Calculated by author through SPSS software

INDIA →

$$ER = (D2 = 0, D3 = 0)$$

$$= \beta 0 + \beta 1 GDP + ui$$

$$= 50.787 + 2.381 GDP + ui$$

CHINA →

$$ER = (D2 = 1, D3 = 0)$$

$$= \beta 0 + \beta 1 GDP + \beta 2 + \beta 4 GDP$$

$$= (\beta 0 + \beta 2) + (\beta 1 + \beta 4)\, GDP + ui$$

$$= (50.787 - 41.242) + (2.381 - 2.283) GDP + ui$$

$$= 9.545 + 0.98 GDP + ui$$

USA →

$$ER = (D2 = 0, D3 = 1)$$

$$= \beta 0 + \beta 1 GDP + \beta 3 + \beta 5 GDP$$

$$= (\beta 0 + \beta 3) + (\beta 1 + \beta 5)\, GDP + ui$$

$$= (50.787 - 49.296) + (2.381 - 2.4) GDP + ui$$

$$= 1.491 - 0.019 GDP + ui$$

From the above result of regression we can see that GDP is significant under 9 percent level of significance only in India, for rest of the countries it is insignificant. Now we will about how far exchange rate changes with the change in GDP. In India the impact of GDP on exchange rate is 2.381 units which means as GDP increases exchange rate will increase by 2.38 units that show that currency will depreciate instead of appreciating which is not as per the theory stated in table 5.1. When we talk of China we can see that as GDP increases exchange rate will also increase by .98 units which means currency is depreciating by .98 units rather it has to increase. In USA GDP is negatively correlated which means as GDP increases exchange rate will go down which signifies that currency will appreciate by .019 units. So we can trace currency misalignment in case of all three economies with respect to GDP.

5.4.3 Pattern of Currency Misalignment with Respect to Interest Rate

Table 5.5 Regression Result of Real Interest Rate

Model		Un standardized Coefficients		Standardized Coefficients	t	Significance
		B	Std. Error	Beta	B	Std. Error
	(Constant)	74.748	4.545		16.447	.000
	INTR	-1.485	.753	-.152	-1.974	.052
	D2	-64.233	5.028	-.996	-12.776	.000
	D3	-73.235	6.103	-1.136	-12.000	.000
	INTRD2	1.478	.926	.107	1.595	.115
	INTRD3	1.467	1.226	.101	1.197	.235

Dependent Variable: ER Source: Calculated by author through SPSS software

INDIA →

$$ER = (D2 = 0, D3 = 0)$$

$$= \beta 0 + \beta 1 INT + ui$$

$$= 74.748 - 1.485 INT + ui$$

CHINA →

$$ER = (D2 = 1, D3 = 0)$$

$$= \beta 0 + \beta 1 INT + \beta 2 + \beta 4 INT$$

$$= (\beta 0 + \beta 2) + (\beta 1 + \beta 4)\, INT + ui$$

$$= (74.748 - 64.233) + (-1.485 + 1.478)\, INT + ui$$

$$= 10.515 - 0.007 INT + ui$$

USA →

$$ER = (D2 = 0, D3 = 1)$$

$$= \beta 0 + \beta 1 INT + \beta 3 + \beta 5 INT$$

$$= (\beta 0 + \beta 3) + (\beta 1 + \beta 5)\, INT + ui$$

$$= (74.748 - 73.235) + (-1.485 + 1.467)\, INT + ui$$

$$= 1.513 - 0.018 INT + ui$$

From the above table it can be seen that interest rate is significant under 9 percent level of significance only in India, for rest of the countries it is insignificant. Now we will talk about the correlation between exchange rate and interest rate. On an aggregate interest rate are 74.748 which explain the exchange rate of all the three countries viz. India, China and USA. In India the interest rate is negatively correlated that means as interest rate increases, exchange rate will decrease by 1.485 units which are as per the theory. When we turn to China we can see that as interest rate increases exchange rate will go down by .007 units which mean currency is appreciating only by .007 units. The interest rate of USA is also negatively correlated which means as interest rate goes up exchange rate will decline by 0.018 units which signify that currency will appreciate only by .018 units. So with respect to interest rate we find that correlations are as per theory but it has no significance in China and USA because we can see that the values are so minute that it has almost no impact. .

5.4.4 Pattern of Currency Misalignment with Respect to Inflation

Table 5.6 Regression Result of Inflation

Model	Un standardized Coefficients		Standardized Coefficients	t	Significance
	B	Std. Error	Beta	B	Std. Error
(Constant)	78.468	4.727		16.600	.000
INF	-1.579	.578	-.228	-2.730	.008
D2	-68.079	5.257	-1.056	-12.950	.000
D3	-77.008	6.644	-1.194	-11.590	.000
INFD2	1.605	.663	.204	2.422	.018
INFD3	1.573	1.904	.065	.826	.411

Dependent Variable: ER Source: Calculated by author through SPSS software

INDIA →

$$ER = (D2 = 0, D3 = 0)$$

$$= \beta 0 + \beta 1 INF + ui$$

$$= 78.468 - 1.579 INF + ui$$

CHINA →

$$ER = (D2 = 1, D3 = 0)$$

$$= \beta 0 + \beta 1 INF + \beta 2 + \beta 4 INF$$

$$= (\beta 0 + \beta 2) + (\beta 1 + \beta 4)\, INF + ui$$

$$= (78.468 - 68.079) + (-1.579 + 1.605)\, INF + ui$$

$$= 10.389 + 0.026 INF + ui$$

USA →

$$ER = (D2 = 0, D3 = 1)$$

$$= \beta 0 + \beta 1 INF + \beta 3 + \beta 5 INF$$

$$= (\beta 0 + \beta 3) + (\beta 1 + \beta 5)\, INF + ui$$

$$= (78.468 - 77.008) + (1.579 + 1.573)\, INF + ui$$

$$= 1.46 - 0.006 INF + ui$$

From the above data we can notice that inflation is negatively correlated in case of India and USA which is not as per the theory while it is positively correlated to China. The increase and decrease of currency units due to inflation is significant in case of India i.e. 1.579 units but for rest of the countries it is insignificant because the increase and decrease of currency units is too low between 0 and 1, and when we look at the p value it also denotes the same.

5.4.5 Pattern of Currency Misalignment with Respect to Current Account Balance

Table 5.7 Regression Result of Current Account Balance

Model	Un standardized Coefficients		Standardized Coefficients	T	Significance
	B	Std. Error	Beta	B	Std. Error
(Constant)	62.235	2.573		24.190	.000
CAB	-3.425	1.393	-.354	-2.459	.016
D2	-52.203	3.806	-.809	-13.715	.000
D3	-60.827	4.814	-.943	-12.636	.000
CABD2	3.581	1.558	.246	2.298	.024
CABD3	3.411	1.872	.181	1.822	.072

Dependent Variable: ER

Source: Calculated by author through SPSS software

INDIA →

$$ER = (D2 = 0, D3 = 0)$$

$$= \beta 0 + \beta 1 CAB + ui$$

$$= 62.235 - 3.425 CAB + ui$$

CHINA →

$$ER = (D2 = 1, D3 = 0)$$

$$= \beta 0 + \beta 1 CAB + \beta 2 + \beta 4 CAB$$

$$= (\beta 0 + \beta 2) + (\beta 1 + \beta 4)\, CAB + ui$$

$$= (62.235 - 52.203) + (-3.425 + 3.581)\, CAB + ui$$

$$= 10.032 + 0.156 CAB + ui$$

USA →

$$ER = (D2 = 0, D3 = 1)$$

$$= \beta 0 + \beta 1 CAB + \beta 3 + \beta 5 CAB$$

$$= (\beta 0 + \beta 3) + (\beta 1 + \beta 5)\, CAB + ui$$

$$= (62.235 - 60.827) + (-3.425 + 3.411)\, CAB + ui$$

$$= 1.408 - 0.014 CAB + ui$$

*A*s we all know that India and USA, both are deficit economy whereas China is a surplus economy and the trend analysis of earlier chapter proves the same. We can see from the above table that as current account balance increases exchange rate of India and USA will decrease that means currency will appreciate. Though the currency value of USA is increasing but its current account balance is in deficit but in India the current account balance is in deficit so its currency is depreciating. On the other hand when we look at Chinese currency and its current account balance it seems opposite. The currency of China should appreciate as its CAB is in surplus but it is depreciating. The current account balances of all the three economies are insignificant in determining the exchange rates of the respective countries.

5.5 Conclusions

Table 5.8 Factors of India and its Resulting Response to Currency Value

Factors	Change in Factors	Currency value
Domestic interest rate	↑	↑
Expected domestic price level	↑	↑
Current account balance	↑	↑
Expected productivity	↑	↓

Source: Calculated by author

Table 5.9 Factors of China and its Resulting Response to Currency Value

Factors	Change in Factors	Currency value
Domestic interest rate	↑	↑
Expected domestic price level	↑	↓
Current account balance	↑	↓
Expected productivity	↑	↓

Source: Calculated by author

Table 5.10 Factors of USA and its Resulting Response to Currency Value

Factors	Change in Factors	Currency value
Domestic interest rate	↑	↑
Expected domestic price level	↑	↑
Current account balance	↑	↑
Expected productivity	↑	↑

Source: Calculated by author

In India the GDP growth and inflation is significant while CAB and interest rates is insignificant. But in case of China and USA all the four fundamental variables are insignificant which we can see from p value of regression result. On the other hand when we talk of exchange rate determination with respect to the movement of four fundamental variables i.e. GDP growth, interest rate, inflation and CAB only interest rate of all three economies supports the theory rest of three variables are not supporting the theory. So from the empirical analysis we can say that in determining exchange rate there are some artificial interventions which deviates the exchange rate movement with respect to the movement of fundamental variables. As a result we can say that exchange rates do not follow the movement of fundamental variables and currency misalignment is present in case of all the three economies. The data which is observed here is a long period but still we can analyze that there is misalignment, so we can conclude that misalignment in long run do not correct itself rather it exists in long run too.

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CHAPTER 6
CONCLUSIONS
AND
POLICY PRESCRIPTIONS

6.1 Conclusions

The study aimed to identify the misalignment between foreign exchange rate and fundamental variables with respect to India, China and USA from 1991 to 2017. Here misalignment is when exchange rate does not follow the fundamental variables. There are many researches that focused currency misalignment, but as of now no study compares the misalignment of India, China and USA and considers determination of exchange rate through fundamental variables as a short run phenomenon, though these countries are great examples of currency misalignment. Exchange rates are very much volatile due to the collapse of Bretton Wood system in 1973. Since then lot many researches has been undertaken to understand the behavior of exchange rate movements. The exchange rate is the price of domestic currency relative to foreign currency. Since the exchange rate directly affect international prices of goods and services and financial assets, the relative value of currencies are of great importance in determining exports and imports of countries and the exchange of financial assets in global market according to various researchers, economists etc. Exchange rate misalignment may be harmful for relative price due to “unsound economic policies”. If it persists may indicate the presence of macroeconomic imbalances that may lead to macroeconomic crises and especially when exceed beyond certain threshold value, disruptive exchange rate adjustment. Exchange rate forecast is quite necessary for policy maker to determine the output and inflation in the economy. As markets are globalised nowadays exchange rate misalignments are pretty much focused in recent years. China is a very interesting example for understanding the importance of the exchange rate in determining trade and growth trends of countries, the focus is on this country. As the United States is the largest trading partner of China, so it is the most affected country by China’s devalued currency. Because of their trade war developing countries like India is also affected by it. This study revolves around three objectives, first is to study the pattern of movement of fundamental variables of the respective countries, and second is to analyze the variation in exchange rate with respect to fundamental variables of the respective countries, third and final objective is to study the pattern of misalignment between fundamental variables and exchange rate determination. All the data in this study is secondary data and its main sources are IMF e library and world development indicator of World Bank. The methodologies

that I have used here are trend analysis, basic statistical tools (average, min, max and variance) and linear regression with dummy variables. So, this study is divided into two core chapters and a main chapter.

The objective of first core chapter is to trace the pattern of movement of fundamental variables of India, China and USA and its hypothesis is fundamental variables of India, China and USA have shown almost similar trend in the post reform period i.e. 1991. The fundamental variable that is included in the chapter is GDP growth, interest rate, Inflation and current account balance of the three countries. In order to show the movements of fundamental variables of respective countries trend analysis and basic statistical tools has been used. The time period are divided into two sub-periods viz. normal and recessionary period. Through trend analysis and basic statistical tool we find that these countries do not show similar trends in terms of movement in fundamental variables. As we all know that China is one of the emerging and fastest growing economies of the world so Chinese economy is performing very well in terms of its fundamental variables while India is also performing well but USA economy is stagnant in terms of its fundamental variables although it is one of the developed and strongest economy of the world. After comparing the three economies it is concluded that India and China is growing swiftly in terms of its fundamental variables of economic growth. On the other hand economic growth of US economy is not performing well as compared to India and China. After the reforms China is the fastest growing economy of the world and India is an emerging economy and is performing well in terms of economic growth. In terms of recessions India and China were affected by 1998 recession while US economy was adversely hit by the global financial crises and dot com bubble burst. The variance was least in USA with respect to the movement of fundamental variables which proves that its fundamental variables are not performing. At the same time India and China showed variations with respect to the movement of fundamental variable. So we can conclude that the fundamental variables are of the three economies are following dissimilar trend and affecting differently by recessions.

The purpose of the second core chapter is to observe the variation between fundamental variable and exchange rate determination. The hypothesis for this chapter is variation in exchange rate of these countries follows the movement of

fundamental variables. In this chapter we divide our comparisons in three parts, firstly we compare China and India then we compared USA with India and lastly we compared USA and China and the basis of comparisons is differences in the movement of fundamental variables. In this chapter also we used the same technique as in Chapter 3, i.e. trend analysis and basic econometric tools; at the same time we also used the differentials of fundamental variables of the respective countries and their exchange rate to analyze the variations. Our main finding of the chapter is the variation in exchange rate is not as per the movement of fundamental variables. Various theories, articles and journal already tell us the relationship of variable with exchange rate and which variable determines the exchange rate of a country. On the contrary GDP growth and inflation determines the exchange rate in the long run whereas CAB and interest rate determines the exchange rate in the short run as it is a part of money market and money market respond faster than goods market. On the behalf of the descriptive statistical tools used in analyzing the variation, we can conclude that there are movements in fundamental variables of China and India while we cannot observe much variation with respect to the movement of fundamental variables of USA. When we compare the productivity differential, interest rate differentials, price level differentials, CAB differentials of China and India we analyzed that the variance value of all four differentials are moving up and down with the time but we cannot analyze much variance in their exchange rate. Similarly, we compared India and USA all the four differentials were varying with time but exchange rate of both the countries was showing high variance in their exchange rate especially during 2010-2017. And the movements of exchange rate between these two countries are much higher than the movement of their fundamental variable. At the same time we can also observe the same thing in the trend analysis too India's SDR was high while USA's SDR was stagnant though their fundamental variables were moving, things are beyond theory. As per theory of determination of exchange rate in long run and short run INR should appreciate as the movement of its fundamental variable was in favor of appreciation, while USD should depreciate as its fundamental variable was against appreciation. Lastly we compared USA to China, from the trend analysis we can notice that USA's SDR was constant while China's SDR was moving up and down with the time but the movement was very slight especially after 1995. Now when we talk of their fundamental variables we analyzed that China's currency should be appreciated and USA's currency should be depreciated with respect to the

movement of their fundamental variables but scenario is just opposite to the theory. On the behalf of basic statistical tool we can analyze that the four differentials variations were high but we cannot analyze much variation in their exchange rates, even its variance value was 0 from 1999- 2006.

Now the main and final chapter, it aimed to show the pattern of misalignment between performance of fundamental variables and exchange rate determination. Here independent variables are GDP growth rate, interest rate, inflation and current account balance and dependent variable is SDR of the respective countries. Firstly unit root tests are applied to each independent variable to check the stationarity, from Hadri LM unit root tests we get to know that data are stationary at first difference so we can use original data as they are of same order as stated in the theory of co integration. Then fixed effect LSDV model is used to find the results, in this we used dummy variables and linear regression to interpret the results, four models for each independent variable are used to estimate the result. The hypothesis of the chapter is misalignment between fundamental variables and exchange rate of these countries is short run phenomena and in the long run it corrects the misalignment in itself. The main findings of this study are: In India the GDP growth and inflation are significant at 10 percent level of significance while CAB and interest rate are insignificant. But in case of USA and China all the four fundamental variables are insignificant which we can see from p value of regression result. On the other hand when we talk of exchange rate determination with respect to the movement of four fundamental variables i.e. GDP growth, interest rate, inflation and CAB only interest rate of all three economies supports the theory rest of three variables are not supporting the theory. So from the empirical analysis we can say that in determining exchange rate there are some artificial interventions which deviates the exchange rate movement with respect to the movement of fundamental variables. As a result we can say that exchange rates do not follow the movement of fundamental variables and currency misalignment is present in case of all the three economies. The data which is observed here is a long period but still we can observe that there is misalignment, so we can say that misalignment in long run do not correct itself rather it exists in long run too. There is misalignment between movement of fundamental variables and exchange rate determination and this misalignment does not correct itself in long run rather it is present in long run as well as in short run.

6.2 Policy Prescription

1. In the context of increasing share of International trade of world GDP, It is recommended to establish a strong, stable and legal International currency system.

2. International currency system must be linked to fundamental macro variables of world economy. Further, fundamental variables of world economy must be fairly defined and linked to fundamental real variables of different countries/ economies.

3. For establishing a fair International currency system, there must be strong, vibrant and self-dependent International institutions/world organisations.

4. Institutions like IMF, World Bank, UNO must be strengthened and they must work like word government/ institution in real sense.

6.3 Suggestions for future research

In this study we examined that there are some external factors that deviates the exchange rate determination and the movement of fundamental variable in the long run.

1. What are those external factors that affect exchange rate determination and movement of fundamental variable in the long run?

2. To what extent these external factors affect the exchange rate determination.

6.4 Limitations of the Study

In spite of being very thorough and executed the study with a well defined methodology, the design of current study is subject to certain limitations that could be addressed in future which are given below:

5. While collecting the data from data source, some data of US economy was missing, so we used Average method to overcome the difficulty.
6. We have used some trading sites to fetch the data of exchange rate of India and China because this Data is unavailable on IMF and World Bank.

7. We can also use the differentials of independent variables i.e. interest rate differential, Growth differential, Export differential and price level differential.

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APPENDICES

Appendix

7.1 Exchange rate of India China and USA

Period	INR/CNY	INR/USD	CNY/USD
1991	4.25	22.74	5.32
1992	5.09	25.92	5.51
1993	5.41	30.49	5.76
1994	3.63	31.37	8.62
1995	3.87	32.43	8.35
1996	4.25	35.43	8.31
1997	4.39	36.31	8.29
1998	5	41.26	8.28
1999	5.21	43.06	8.28
2000	5.44	44.94	8.28
2001	5.71	47.19	8.28
2002	5.87	48.61	8.28
2003	5.63	46.58	8.28
2004	5.47	45.32	8.28
2005	5.38	44.1	8.19
2006	5.67	45.31	7.97
2007	5.41	41.35	7.61
2008	6.26	43.51	6.95
2009	7.07	48.41	6.83
2010	6.7	45.73	6.77
2011	7.22	46.67	6.46
2012	8.46	53.44	6.31
2013	9.54	58.6	6.2
2014	9.9	61.03	6.14
2015	10.2	64.15	6.23
2016	10.11	67.2	6.64
2017	9.37	65.12	6.76

Source: IMF exchange rates and Fxtop.com

Notes: India and China exchange rate has been taken from fxtop.com (a trading site) as it was unavailable at IMF.

7.2 SDR of India, China and USA

Period	SDR of India	SDR of China	SDR of USA
1991	36.95	7.77	1.43
1992	36.03	7.91	1.38
1993	43.1	7.97	1.37
1994	45.81	12.33	1.46
1995	52.29	12.36	1.49
1996	51.67	11.93	1.44
1997	53	11.17	1.35
1998	59.81	11.66	1.41
1999	59.69	11.36	1.37
2000	60.91	10.78	1.3
2001	60.55	10.4	1.26
2002	65.3	11.25	1.36
2003	67.77	12.3	1.49
2004	67.69	12.85	1.55
2005	64.41	11.53	1.43
2006	66.56	11.75	1.5
2007	62.29	11.54	1.58
2008	74.63	10.53	1.54
2009	73.18	10.7	1.57
2010	69.01	10.2	1.54
2011	81.77	9.67	1.54
2012	84.19	9.67	1.54
2013	95.32	9.4	1.54
2014	91.75	8.87	1.45
2015	91.91	9	1.39
2016	91.35	9.34	1.34
2017	91.04	9.27	1.42

Source: IMF exchange rates Daily updates

7.3 Differentials of fundamental variables of China and India

Period	Productivity Differential	Interest rate Differential	Price level Differential	Export/Import Differential
1991	8.23	-1.79	-10.31	5.05
1992	8.74	-8.72	-5.44	3.06
1993	9.12	-9.48	8.25	-1.94
1994	6.39	-12.32	14.05	1.73
1995	3.38	-7.28	6.57	1.76
1996	2.38	-4.43	-0.67	2.36
1997	5.18	0	-4.37	4.55
1998	1.66	2.23	-14	4.7
1999	-1.18	-1.98	-6.07	2.63
2000	4.65	-4.63	-3.66	2.67
2001	3.52	-4.86	-2.96	1.01
2002	5.33	-3.23	-5.12	1.04
2003	2.18	-4.67	-2.68	1.15
2004	2.19	-6.19	0.05	3.42
2005	2.12	-3.25	-2.47	7.04
2006	3.46	-0.46	-4.5	9.41
2007	4.43	-5.99	-1.55	10.6
2008	5.76	-6.1	-2.42	11.73
2009	0.92	0.64	-11.61	6.71
2010	0.38	0.92	-8.81	7.15
2011	2.9	-2.79	-3.31	5.23
2012	2.4	1.05	-6.69	7.52
2013	1.37	-0.18	-8.29	4.19
2014	-0.11	-1.97	-4.74	3.59
2015	-1.25	-3.31	-3.47	3.82
2016	-0.41	-3.17	-2.95	2.34
2017	0.22	-5.18	-1.74	2.79

Source: Calculated by author through MS excel

7.4 Differentials of fundamental variables of USA and India

Period	Productivity differentials	Interest rate differential	Inflation differential	Export/Import differential
1991	1.13	-1.35	9.64	-1.64
1992	1.92	5.25	8.76	-0.77
1993	2	2.27	3.41	0.56
1994	2.62	-0.57	7.6	1.15
1995	4.85	-0.75	7.41	-0.06
1996	3.75	1.46	6.05	0.02
1997	-0.44	0.29	4.82	0.92
1998	1.73	-2.07	11.68	0.73
1999	4.16	2.82	2.48	2.28
2000	-0.25	1.54	0.63	2.94
2001	3.84	4.05	0.85	3.96
2002	2.01	4.82	2.8	5.48
2003	5.05	5.22	1.54	5.95
2004	4.13	3.36	1.09	5.26
2005	5.93	1.98	0.86	4.44
2006	6.59	-2.17	2.92	4.83
2007	8.02	0.43	3.52	4.25
2008	4.18	0.7	4.51	2.05
2009	11.26	2.34	11.24	0.63
2010	7.73	-3.98	10.35	-0.37
2011	5.04	0.18	5.7	-0.56
2012	3.24	1.16	7.24	-2.36
2013	4.71	2.4	9.45	-0.57
2014	4.84	5.37	5.04	0.74
2015	5.29	5.39	4.79	1.17
2016	5.62	3.96	3.69	1.78
2017	4.41	3.5	1.2	0.86

Source: Calculated by author through MS excel

7.5 Differentials of fundamental variables of USA and China

Period	Productivity differentials	Interest rate differentials	Inflation differentials	Export/Import differentials
1991	-9.36	3.14	0.67	-3.41
1992	-10.66	3.47	-3.32	-2.29
1993	-11.12	7.21	-11.66	1.38
1994	-9.01	12.89	-21.65	-2.88
1995	-8.23	8.03	-13.98	-1.7
1996	-6.13	2.97	-5.38	-2.38
1997	-4.74	-0.29	-0.45	-5.47
1998	-3.39	-0.16	2.32	-5.43
1999	-2.98	-0.84	3.59	-4.91
2000	-4.4	3.09	3.03	-5.61
2001	-7.36	0.81	2.11	-4.97
2002	-7.34	-1.59	2.32	-6.52
2003	-7.23	-0.55	1.14	-7.1
2004	-6.32	2.83	-1.14	-8.68
2005	-8.05	1.27	1.61	-11.48
2006	-10.05	2.63	1.58	-14.24
2007	-12.45	5.56	-1.97	-14.85
2008	-9.94	5.4	-2.09	-13.78
2009	-12.18	-2.98	0.37	-7.34
2010	-8.11	3.06	-1.54	-6.78
2011	-7.94	2.61	-2.39	-4.67
2012	-5.64	-2.21	-0.55	-5.16
2013	-6.08	-2.22	-1.16	-3.62
2014	-4.73	-3.4	-0.3	-4.33
2015	-4.04	-2.08	-1.32	-4.99
2016	-5.21	-0.79	-0.74	-4.12
2017	-4.63	1.68	0.54	-3.65

Source: Calculated by author through MS excel