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Validity of Purchasing Power Parity (PPP) during 2000-01-2009-10 and Relationship between Nominal Exchange Rate (NER),Real Exchange Rate (RER), Nominal Effective Exchange Rate (NEER), Real Effective Exchange Rate (REER) on Balance of Trade (BoT)

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Abstract:
This paper studies the validity of purchasing power parity (PPP) during 2000-2010 period in India and the relation between PPP and balance of trade.
This paper also attempts to analyze the effect of nominal exchange rate (NER), real exchange rate (RER), nominal effective exchange rate (NEER), and real effective exchange rate (REER) on India's balance of trade during 2000-2010. While analyzing the effect of various types of exchange rate on balance of trade, oil trade balance, non oil trade balance and total trade balance are studied separately.

Keywords: Balance of trade, nominal exchange rate, nominal effective exchange rate, purchasing power parity ,real exchange rate, real effective exchange rate.

1. Introduction
In this chapter the validity of Purchasing Power Parity (PPP) in India, which is a crucial element of monetary approach, tested during the period of 2000-01-2009-10. Also studied in this chapter the effect of NER, RER, NEER and REER on India's BoT for the same above mentioned period.
Nominal Exchange Rate states the home currency price of foreign exchange. This is the usual bilateral exchange rate. A Real Exchange Rate is a price adjusted nominal exchange rate. Real exchange rate is the nominal exchange rate adjusted by the ratio of foreign to domestic price levels. Nominal Effective Exchange Rate which is calculated by taking weighted average of exchange rates of the domestic currency and the nation's most important trade partners with weights given by the relative importance of the nation's trade with each of these trade partners. Real Effective Exchange Rate (REER) which is calculated by deflating the price effect a weighted average of exchange rates of the domestic currency and the nation's most important trade partners with weights given by the relative importance of the nation's trade with each of these trade partners.(In India it is calculated by RBI and it is a weighted average of exchange rate of 36 most traded countries of India). When the price of foreign currency in terms of the domestic currency is rising it is depreciation of nominal and real exchange rates. But when the NEER and REER indices are rising it is an appreciation of NEER and REER.
Purchasing Power Parity theory (absolute PPP)postulates that the equilibrium exchange rate between two countries is equal to the price level of two countries. Nominal exchange rate is the exchange rate is the number of domestic currency required to purchase one foreign currency. Real exchange rate is the nominal exchange rate adjusted to the price level. The indices of nominal effective exchange rate (NEER) and real effective exchange rate (REER) are used as indicators of external competitiveness of the country over a period of time. NEER is the weighted average of bilateral nominal exchange rates of home currencies in terms of foreign currencies of its major trading partners. REER is defined as a weighted average of nominal effective exchange rates adjusted for relative price differential between the domestic and foreign countries. REER captures movements in cross-currency exchange rates as well as inflation differentials between India and its major trading partners.RBI has been constructing six currencies (US dollar, euro for euro zone, pound sterling, Japanese yen, Chinese renminbi and Hong Kong dollar and 36 currency indices for NEER and REER.REER relates to PPP hypotheses. Increase in the NEER and REER indices indicates an appreciation of domestic currency.

2. Relationship between NER and RER

Real exchange rate has been appreciating during the period 2002-2007.If the nominal exchange rate reflected changes in relative prices in India and in U.S. (as postulated by the PPP theory), then the real exchange rate should be the same as or remain in the same proportion to the nominal exchange rate.
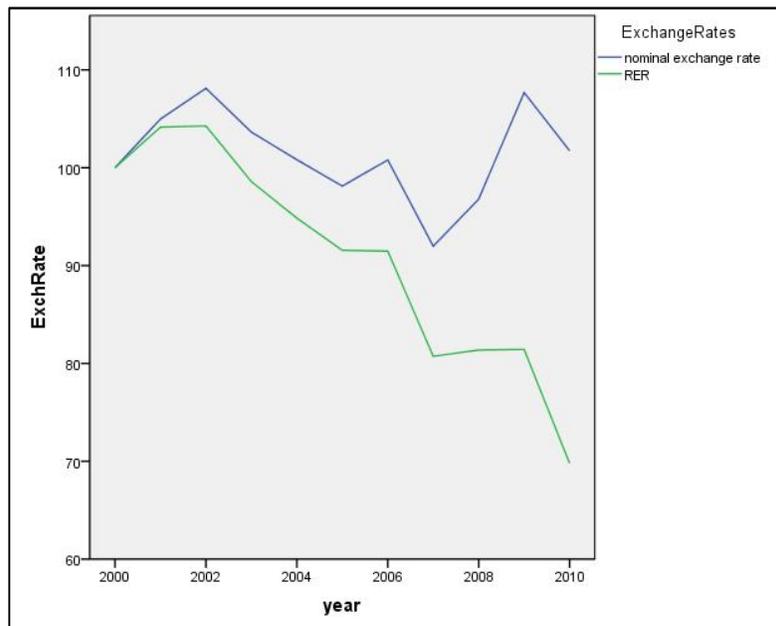
Figure 1

This figure shows nominal and real exchange rate index (with2000=100) between Indian rupee and US $.from2000 to 2010.Since the nominal and real exchange rates became increasingly different during this period, the PPP theory, as a crucial element of monetary approach, did not seem to hold for these years. The two exchange rates did, however, move together during this period.

3. Movements of India's Nominal Exchange Rate ,Price level, Real Exchange Rate , and Real Effective Exchange Rate During the Period 2000-01 to 2009-10.

In this chapter nominal exchange rate is considered of Indian rupee in relation with U.S. $. During the period of study that is from 2000-01 to 2009-10 it fluctuated from Rs. 43.55 / 1US$ in January 2000 to 45.15/1US$ in December 2010.Though it seems the increase of only 3.67 % there is wide fluctuation between these two periods. Between January 2000 when the rate was Rs. 43.55/ 1US$ and October 2001the $ exchange rate escalated to Rs 48.01.(10 % increase).With the fluctuations in the exchange rate in between it came down to Rs. 43.48/1US$ in May 2005.(9% decline).It increased again to Rs.46.53/1US$ in August 2006.(7% increase).In January 2008 the rate was Rs.39.37/1US$.That is the decline of more than 15% from August 2006.During a short period of time that is in March 2009 within 15 months the rate increased to Rs. 51.22/1US$.That is the increase of 30 %. During the period of study the lowest exchange rate was Rs.39.37/1US$ in January 2008 and the highest exchange rate was Rs. 51.22/1US$ in March 2009. It is interesting to see the changes year wise. In the year 2000 January month had the lowest exchange rate. It was Rs.43.55/ 1US$.and in the month of November it was Rs.46.77/ 1US$.The fluctuation between the lowest and the highest exchange rate in the year 2000 was 7.39%. During the year 2001 the month of February saw the lowest rate which was Rs.46.51/ 1US$. The fluctuation of 3.22% made the highest rate in that year Rs.48.01/ 1US$ in the month of October 2001.The year 2002 saw the most stable year of the fluctuations in the exchange rate of the study period. The minimum rate was Rs.48.14/ 1US$ in the month of December and the month May saw the rate Rs.48.99/ 1US$.The fluctuation of only 1.76%.The year 2003 saw the fluctuation of 5.6%. with the lowest rate in that year was Rs.45.38/ 1US$ in the month of October and the highest was Rs.47.93/ 1US$ in the month of January of the same year. In the year 2004 the rate changed in the range of 5.48% with the lowest at Rs.43.93/ 1US$ in April and the highest was in Rs.46.34 / 1US$ in the month of August. The year 2005 and 2006 also saw the same level of fluctuation. The year 2007 saw the large fluctuation of 12.42% in the exchange rate. With the lowest rate of Rs.39.43/ 1US$ in the month of November and the highest was Rs.44.33/ 1US$ in the month of January. In the entire decade of study the highest fluctuation was in the year 2008. The rate fluctuated in the range of   Rs.39.37 / 1US$ in the month of January to Rs.48.99/ 1US$ in the month of November. The fluctuation of 24.43% in the exchange rate brought the waves of uncertainty in the foreign exchange market. If we consider only the year 2008 and the year 2009 these give the lowest and the highest exchange rate in the entire decade. It means the range of change in the exchange rate was Rs.39.37/ 1US$ in January 2008 and in March 2009 it was Rs.51.22/ 1US$.Thus in the period of 15 months the rate fluctuated by 30%.In this fifteen months period the lowest and the highest exchange rate of the entire decade was seen. Thus the year wise the lowest fluctuation took place in the year 2002(1.77%) and the highest fluctuation took place in the year 2008(24. 43%).Most of the years i.e. the years 2003, 2004, 2005, 2006,and 2010 saw the change in the exchange rate of around 5.4%.

4. Price Level Change (WPI) During 200-01 to 2009-10

In the entire decade the lowest increase in WPI was seen in the year 2001 which was 2% and the highest was seen in the year 2009 which was 8.43%.The year 2002 and 2007 saw the increase in WPI of about 3.6%.Most of the years like 2003, 2004,and 2008 saw the increase in WPI of about 5%.The year 2006 also saw the higher growth in WPI of more than 6%.To validate the PPP theory the price level and the nominal exchange rate should move in the same proportion. But in that case the foreign price level also should be considered.

4.1. Real Effective Exchange Rate (REER)

As it is mentioned above that while the nominal and real exchange rate did move together over time, they became increasingly different. In case of NER and RER when their indices are *increasing* (when the value of currency is falling) it is the *depreciation* and when their indices are *declining* (when the currency becomes stronger) is it is an *appreciation.*   In case of REER when the index is *increasing* it is an *appreciation* and when the index is *declining* it is the *depreciation*. That is why the same results are expected when indices of NER and RER are increasing and the index of REER is decreasing. The graph shows the exact opposite trends of the changes between NER, RER and REER. It also means, as explained above, NER, RER and REER are moving in the same direction.
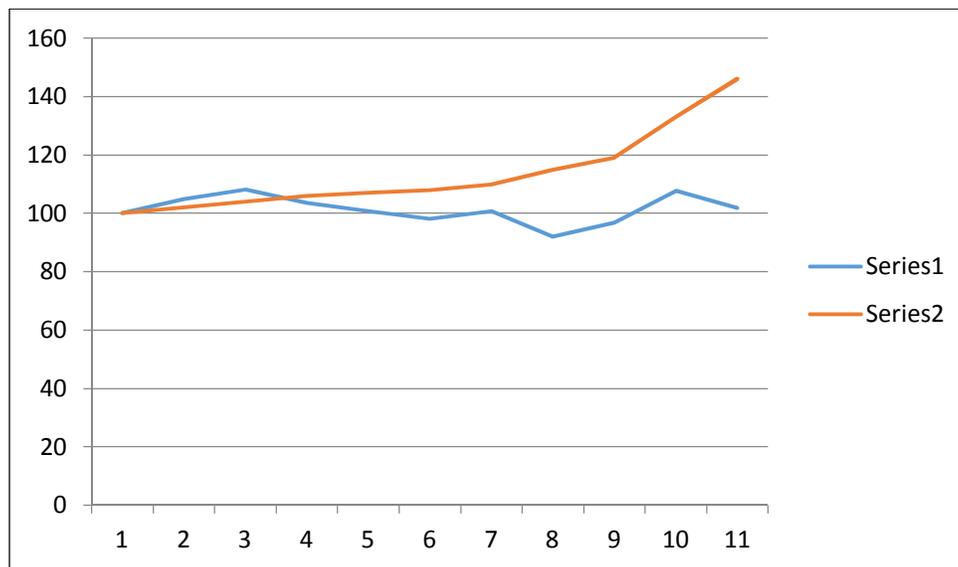
Figure 2

Thus the graphs of NER and RER show that the two exchange rates moved together in those years. In case of the rest of the years graph of nominal exchange rate shows   more volatility than the volatility in US India price level ratio, that is the volatility of real exchange rate. In the case of nominal exchange rate there is a depreciation from the year 2000 to 2002 afterwards there is an appreciation of Indian currency vis-a vis US$ till the year 2005 and then afterwards till the end of the year 2010 there is volatility that is this period is seen by the appreciation and the depreciation of the Indian currency vis-à-vis US$. In case of US India price level, that is real exchange rate there is a steady decline in the ratio throughout the period. The gap between nominal exchange rate and the US India price level ratio was lowest in the year 2007 that is in the year nominal exchange rate was closer to real exchange rate which validates the PPP theory. Afterwards the gap between these two variables started widening thus moving the nominal exchange rate far away from PPP. The gap was widest in the year 2010. While calculating US India price level the CPIs of two countries are considered which is calculated by IMF so making careful adjustments for inter country quality differences among supposedly identical goods. These comparisons typically conclude that absolute PPP is away off the mark. For comparison of nominal exchange rate and US India price level the year 2000 has taken as a base year Thus both the variables are compared on the same platform.

4.2. Real Exchange Rate (RER)

Real exchange rate is the nominal exchange rate adjusted with the price level of both the countries. That is the real exchange rate is the nominal exchange rate divided by the ratio of the consumer price index of US and to the consumer price index of India. If the nominal exchange rate reflected changes in the relative prices of US and India (as postulated by PPP theory), then the real exchange rate should be the same as or remain in the same proportion to the nominal exchange rate. While calculating the RER the US and India's price level has been considered for the period of 2000-01 to 2009 -10. What the trend is found in the movements in the NER and RER is that during the period of study they generally have moved in the same direction that is when NER is depreciating RER is also depreciating and when NER is appreciating the RER is also appreciating. But in the case of depreciation of RER the rate at which RER is depreciating compared to NER is much higher. The figure shows, however that while the nominal and real exchange rate did move together over time, they became increasingly different. Thus the crucial element of the monetary approach (i.e., the PPP theory) did not seem to hold. However, the nominal and real exchange rates (even as they remained widely different) did move pretty much together. To compare the nominal and real exchange rate on the equal platform base 100 is taken for both the variables for the year

2000and accordingly the changes are made in both the variables as they depreciate or appreciate. One more interesting feature may be observed between the trends in the movements of NER and RER are those when NER is falling RER falls greater than the fall in NER and when NER is increasing its increase is greater than the increase in RER. Of course it does not have any economic meaning since the movements in RER get affected by the price levels of two countries and also by the movements of nominal exchange rates.

There are two ways the real exchange rate is calculated. First the price levels of two countries used to deflate the nominal exchange rate and the second is the ratio of non tradable to tradable goods prices, it is a critical relative price. It is a measure of real exchange rate .An increase in the relative price of non tradable goods, therefore, corresponds to a real exchange rate appreciation.

India US price level ratio is shown by red curve while India US exchange rate is shown by blue curve. Relative PPP predicts that India US price level ratio and India US exchange rate should move proportionally. In the year 2007 there was a strong appreciation of Indian currency but India US price level ratio increased. In the year2010 again Indian currency appreciated and also India US price level ratio increased sharply. According to the theory in both these years as India US price level ratio increased Indian currency should have depreciated. Thus dramatic violation of relative PPP occurred in these two years. That is there was a complete breakdown of PPP in those years.

The central insight of the modern approach to the analysis of exchange rates is the notion that the exchange rate , being relative price of two durable assets (monies), can be analyzed within a framework that is appropriate for the analysis of asset prices. A key characteristic of the price of an asset is its strong dependence on expectations concerning the future. In an efficient market for assets, new information concerning the future is reflected immediately in current prices and thus precluding unexploited profit opportunities from arbitrage. This distinction between commodity price and asset prices is fundamental for interpreting the deviation from PPP. (Frenkel, 1981).

As discussed before real exchange rate has been appreciating from 2002-2007. The reasons explained are " There is an evolution of prices in the non tradable and tradable sector of the Indian economy for the period 1980-2006 and there is a widening inflation differentials between the two sectors , that is one of the reason why the real exchange rate has been appreciating . This might seem unsurprising, since India's per capita income has been growing rapidly, suggesting the trend in line with the predictions of the Balassa- Samuelson hypotheses. However this theory cannot be the sole explanatory. Since after 1990, the tradable, non tradable labor productivity gap, the driver of a real appreciation according to Balasssa Samuelson has virtually disappeared. In that case both demand and supply factors explain the appreciation. Higher real per capita income in the 1990s accounts for much of the faster growth of non tradable prices during the post reform period. Falling import prices were also an important contribution to the relative price increase along with an expansion in tradable output. This change is significant because the ratio of non tradable to tradable goods prices is a critical relative price. It is a measure of real exchange rate .An increase in the relative price of non tradable goods, therefore, corresponds to a real exchange rate appreciation. Major structural changes in India's economy that might be driving the real appreciation. Amongst other things export growth has been robust since 1990 and the share of tradables in aggregate output has expanded to almost 31% in 2006-07 as against 18% in 1980. Productivity in the traded sector has risen after 1990 , while real per capita growth has accelerated to an average of 5.2% from an average of 3.8% to 3.7% in previous two decades . In summery India is catching up with other countries. An electable process where faster productivity growth in the tradable sector may be leading to resource shift away from non tradable sector , a higher inflation rate, for non tradable and a real appreciation of the exchange rate . At first instance , this result seem unsurprising . Balassa(1964) and Samuelson(1964) argued that real exchange rate typically appreciates, as countries develop and India has been developing rapidly. There is an increase in the relative price of non tradable in India over 1980- 2006. Other reasons for the increase in the relative price of non tradable and so in the appreciation of real exchange rate are demand and supply factors. Demand factor- per capita income growth is been key driving force behind non tradable inflation. Fiscal and reduction in import prices played an important role. Finally it is found small Balassa Samuelson effect it is suspected to be underestimated due to data reasons.There is absence of traded non traded goods price index as in the case for India. It is difficult task to compute this measure of real exchange rate. Defining tradability is a major conceptual issue, necessarily subjective in the absence of concrete and specific information on what goods might potentially traded versus those that are absorbed domestically. Traditionally, 'service and construction' have been assigned to the non tradable category, a notion that has changed with some services being traded. Many researchers also draw a distinction between tradable and traded. Traded goods are defined as items actually entering in to international trade.(exports and imports).and subject to the 'law of one price'. While items that have the potential to be traded (either at 'appropriate relative price' as with improvement in competitiveness, or become transportable, e.g. technological innovation, as with some services) are called tradable. Then there are methodological issues in determining the size and the composition of export and import sectors as distinct subsets of tradable and non tradablesectors.The problem is compounded for India which also lacks a service's price index. Though an attempt has been made by Lal, Bery, and Pant (2003) to compute a traded/non traded price series by classifying the components of the existing (WPI) in to traded and non traded goods , yet more than half of aggregate output is excluded in such a classification. In this study only traded goods are considered. It is then used the allocation criterion proposed by De Gregorio, Giovannini, and Wolff (1994), which is based upon the degree of participation in foreign trade. Thus, if an average of 5 per cent or more of total production of a sector is exported, the category is considered tradable. Compared to the convention of classifying manufacturing as traded and services as nontraded, this method allows a more accurate tradable-nontradable characterization for some services might be traded while some agricultural and manufacturing goods might not. It thus reduces the bias in the measured relative price of nontradables, which could be potentially quite large for India, a significant exporter of services The classification is also dynamic as it allows for changes over time. (Kohli and Mohapatra, 2007) .

Validity of Relative Purchasing Power Parity in Indian Context during 2000-2010 Period . -

5. Whether Relative Purchasing Power Parity theory is valid in India during 2000-2010 periods?

5.1. Validity of Purchasing Power Parity (PPP)
Purchasing Power Parity theory postulates that the equilibrium exchange rate between two countries is equal to the price level of two countries. This is also called as absolute purchasing power theory. Relative purchasing power is the *change* in exchange rate over a period of time should be proportional to the relative *change* in the price level in the two countries. It is considered the absolute PPP the trend from the year 2000 to 2010 which is shown in the diagram. When PPP holds RER remains constant, so that movements in real exchange rates represent deviation from PPP. In the year 2001, 2002, also in 2005, 2006, and in2008, 2009 it is found that the real exchange rates almost remained constant. Thus though the nominal and real exchange rates became increasingly different during this period, the PPP theory, as a crucial element of monetary approach, did not seem to hold for these years,the two exchange rates did, however, move together during this period.

5.2. A simple test of Relative Purchasing Power Parity –
Relative purchasing power is the *change* in exchange rate is equal to the *change* in price level between two countries. To relative PPP to hold exactly the value for the national inflation rate minus the US inflation rate would be identical to the percentage depreciation of the national currency to the US $.
Consumer Price Change (inflation rate) in U.S. and in India (Annual Percentage Change) (Source –International Financial Statistics-Year 2011, IMF Publication).

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
U.S.	3.4	2.8	1.6	2.3	2.7	3.4	3.2	2.9	3.8	- 0.3	1.6
India	4.0	3.7	4.4	3.8	3.9	4.0	6.3	6.4	8.3	10.9	12

Inflation Difference between India and U.S. (India's inflation rate minus U.S. inflation rate)

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
0.6	0.9	2.8	1.	1.2	0.6	3.1	3.5	4.5	11.2	10.4

Nominal Exchange Rate difference (Change in Rs. value per U.S. $. Negative sign shows the appreciation of Indian currency). (Source – Exchange Rate of Indian Rupee vis-à-vis US $ Calendar year, annual average.Handbook of Statistics on Indian economy, Year 2005, 2012, RBI Publication.)

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
4.39	4.98	2.98	-4.13	-2.7	-2.6	2.72	-8.7	5.22	11	-5.5

In the year 2002 it is observed that inflation difference between India and US is 2.8 and Indian currency depreciated by 2.98 % .In the year 2009 it is observed that inflation difference between India and U.S. is 11.2 and Indian currency depreciated in the same period by 11%. That is the difference in the price levels in India and the price level in the US in the year 2002 and 2009 is almost exactly equal to the change in the exchange rate that is depreciation of Indian currency against US$, that is relative PPP occurred in these two year .That also means real exchange rates between India and US remained same during his period. It also means after converting Indian rupee in to US $ at the exchange rate in 2009 the commodity prices remain same compared to the previous year. It is reflected on the countries trade balance in the year 2008-09, 2009-10 and 2010-11, especially in the year 2008-09, 2009-10 . During these years there is not much volatility in country's BoT. It also means India's trade is sensitive to the real exchange rate, which is the nominal exchange rate adjusted for the price level. However that is not the case in the year 2002. That is balance of trade in this period did not respond to the country's real exchange rate.
Otherwise PPP does not seem to hold during the period 2000-01 to 2009-10.

Relationship between Nominal Exchange Rate(NER) ,Real Exchange Rate(RER) ,Nominal Effective Exchange Rate(NEER) , Real Effective Exchange Rate(REER) on Balance of Trade(BoT).
During the period 2001-10 real exchange rate vis-à-vis U.S. $ is appreciating. REER is also appreciating from 2002 to 2007.

- Hypothesis – Depreciationof Nominal Exchange Rate(NER) ,Real Exchange Rate(RER) ,Nominal Effective Exchange Rate(NEER) , Real Effective Exchange Rate (REER) improve India's Balance of Trade (BoT) during 2000 -2010.

Correlations			real exchange rate	oil deficit
Spearman's rho	real exchange rate	Correlation Coefficient	1.000	-.964[**]
		Sig. (2-tailed)	.	.000
		N	10	10
	oil deficit	Correlation Coefficient	-.964[**]	1.000
		Sig. (2-tailed)	.000	.
		N	10	10
**. Correlation is significant at the 0.01 level (2-tailed).				

Table 1

Correlations			real exchange rate	non oil deficit
Spearman's rho	real exchange rate	Correlation Coefficient	1.000	-.927**
		Sig. (2-tailed)	.	.000
		N	10	10
	non oil deficit	Correlation Coefficient	-.927**	1.000
		Sig. (2-tailed)	.000	.
		N	10	10
**. Correlation is significant at the 0.01 level (2-tailed).				

Table 2

Correlations			total deficit	real exchange rate
Spearman's rho	total deficit	Correlation Coefficient	1.000	-.988**
		Sig. (2-tailed)	.	.000
		N	10	10
	real exchange rate	Correlation Coefficient	-.988**	1.000
		Sig. (2-tailed)	.000	.
		N	10	10
**. Correlation is significant at the 0.01 level (2-tailed).				
Correlation coefficient between nominal exchange rate and oil deficit is 0.399				
Correlation coefficient between nominal exchange rate and non-oil deficit is 0.349				

Table 3

Correlations			exchange rate	total deficit
Spearman's rho	exchange rate	Correlation Coefficient	1.000	.394
		Sig. (2-tailed)	.	.260
		N	10	10
	total deficit	Correlation Coefficient	.394	1.000
		Sig. (2-tailed)	.260	.
		N	10	10

Table 4

Correlations			REER1	oildef1
Spearman's rho	REER1	Correlation Coefficient	1.000	-.285
		Sig. (2-tailed)	.	.425
		N	10	10
	oildef1	Correlation Coefficient	-.285	1.000
		Sig. (2-tailed)	.425	.
		N	10	10

Table 5

Correlations			REER1	nonoildef1
Spearman's rho	REER1	Correlation Coefficient	1.000	-.358
		Sig. (2-tailed)	.	.310
		N	10	10
	nonoildef1	Correlation Coefficient	-.358	1.000
		Sig. (2-tailed)	.310	.
		N	10	10

Table 6

Correlations				
			REER1	totaldefl
Spearman's rho	REER1	Correlation Coefficient	1.000	-.309
		Sig. (2-tailed)	.	.385
		N	10	10
	totaldefl	Correlation Coefficient	-.309	1.000
		Sig. (2-tailed)	.385	.
		N	10	10

Table 7

Correlations			
Descriptive Statistics			
	Mean	Std. Deviation	N
NEER	88.7400	2.91844	10
oil	-32756.4700	20079.37580	10

Table 8

Correlations			
		NEER	oil
NEER	Pearson Correlation	1	.457
	Sig. (2-tailed)		.184
	N	10	10
oil	Pearson Correlation	.457	1
	Sig. (2-tailed)	.184	
	N	10	10

Table 9

Correlations			
Descriptive Statistics			
	Mean	Std. Deviation	N
NEER	88.7400	2.91844	10
nonoil	-15893.3600	23444.91690	10

Table 10

Correlations			
		NEER	nonoil
NEER	Pearson Correlation	1	.480
	Sig. (2-tailed)		.160
	N	10	10
nonoil	Pearson Correlation	.480	1
	Sig. (2-tailed)	.160	
	N	10	10

Table 11

Correlations			
Descriptive Statistics			
	Mean	Std. Deviation	N
NEER	88.7400	2.91844	10
total	-48649.7900	43467.24034	10

Table 12

Correlations			
		NEER	total
NEER	Pearson Correlation	1	.470
	Sig. (2-tailed)		.170
	N	10	10
total	Pearson Correlation	.470	1
	Sig. (2-tailed)	.170	
	N	10	10

Table 13

5.3. Conclusion

In the above tables coefficient correlations have been tested between nominal exchange rate   (NER) real exchange rate (RER) real effective exchange rate (REER) and nominal effective exchange rate (NEER) and oil deficit, non oil deficit and total deficit in India's balance of trade during 2000 and 2010. Negative coefficient correlations seem to be exist between RER and REER and oil deficit, non oil deficit and total deficit. But very weak relation seems to be exist between nominal exchange rate (NER) and oil deficit, non oil deficit and total balance of trade deficit. And moderate coefficient correlations found between NEER and oil deficit, non oil deficit and total deficit in India's balance of trade.t means that during the period of study as there is a depreciation of Indian nominal exchange rate there is a slight improvement in India's balance of trade during the period of study and when NEER depreciates moderate improvement can be seen in India's balance of trade that is improvement is seen in oil deficit, non-oil deficit and total deficit vis-a- vis depreciation in NEER. That is this study concludes that during the period of study nominal exchange rates have more impact on tarde balance than the real exchange rates.

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