THE VOLATILITY AND SPILLOVER EFFECT OF OIL PRICE AND TERMS OF TRADE ON EXCHANGE RATES IN INDIA: EVIDENCE FROM PRE AND POST MODI GOVERNMENT

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Abstract

Using a multivariate ARCH (Autoregressive Conditional Heteroskedasticity) and GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model, this paper is attempt to study comparative performance of Indian exchange rates fluctuations during volatility spill over from Brent crude prices and Indian terms of trade (Exports/Imports) during pre and post Modi Government period. This study was divided in two periods (i) UPA-2 (2009M05 to 2014M05) (ii) Modi Government (2014M06 to 2019M05) to evaluate the performance of exchange rates during the periods.

The findings of the study suggested that UPA-2 period was exposed to GARCH effect due to volatility from crude oil price fluctuations. On the contrary, Modi government period was exposed to volatility from Indian terms of trade only. Further, study given confirmatory evidence of ARCH and GARCH volatility during the UPA-2 period but Modi Government period exposed to GARCH effect due fluctuation in ratio to exports to imports only.

Keyword: ARCH (Autoregressive Conditional Heteroskedasticity), GARCH (Generalized Autoregressive Conditional Heteroskedasticity), Exchange Rates, Crude Prices, Terms of trade

Introduction

Crude oil prices remained volatile in past since 2007 when US subprime financial crisis hits the global economy. Countries especially the crude importing one faced the heat in form of surge in cost of crude imports and depleting terms of tradesthat further lead to devaluation of their local currencies against the US dollar. India is a world third largest crude importer therefore, fluctuation in oil prices impacts the real exchnage rate and that lead to uncertainty in micro economy Selmi, Bouoiyour, & Ayachi, (2012). The study of Ghosh, (2011) highlighted the fact that a country's dependence on imported crude oil increase the price of tradable goods in home country than foreign country.

The last decade had seen the surge and collapse of crude prices and the growing uncertainty in exchnage rates. A country role as exporter and importer to crude oil makes a larger impact on its local currency exchnage rates as discussed by Bai & Koong, (2018).

The change in government or regime brings reforms to country foreign trade policy which decides the fate of the investment and trade within the region. Further, the market euphoria for a particular government ask researchers to measure the empirical performance of reforms initiated during a government regime and to compare the same with former government regime to better understand the economic uncertainties prevailing during both the regimes.

This paper attempt to answer the volatility spillover effect due to fluctuations in crude oil price and terms of trade on Indian exchnage rates against dollar. This paper divided in four sections (i) Literature Review (ii) Research Methodology (iii) Empirical Results and Conclusion of the study.

Literature Review

The study of Ji, Liu, & Fan, (2019)analyses the dependence of crude price and the exchnage rate in U.S.A, and China. The study used time varying copula model to study structural changes of dependence into account. A conditional value at risk (CoVAR) approach is also implemented to measure upside and downside risk dependence between crude oil price and exchnage rates. Finally. CoVAR results indicated that there is a significant risk exposure on Chinees and US exchnage rates. Furthermore, the spillover effect in exchnage rate is asymmetrical to rising or falling crude oil returns in China but not in case of U.S.A.

Bai & Koong, (2018) studied the relationship among the oil price, exchnage rate and stock markets of China and U.S.A. The study used variables data ranging from 1991 to 2015. The result of structural VAR (SVAR) revealed that US and Chinees markets responds in same direction to oil price change but with different magnitude. Further, SVAR results indicated that positive oil price shock increases the dollar weighted trade index.

The study of Nouira, Hadj Amor, & Rault, (2018) based on MENA countries (Egypt, Jordon, Morocco, Qatar, Saudi Arabia, Tunisia and UAE) concluded that when price rises that cause exchange rate to soar but not vice versa. Oil price do have a spillover effect on exchnage rates in MENA countries and as demand for crude increase in global markets then there is a significant rise in exchnage rate of the countries. This study finding is contrary to the finding of the study based on crude oil importing countries as MENA region includes most of the oil exporting countries.

Fedoseeva, (2018) studies the time-varying relationship between Russian exchnage rate and crud oil prices. The study used cointegration technique on time series data from 1999 to 2017. The

findings of the study revealed that Rubal exchnage rate against dollar appreciated even during crude oil price collapse of 2014 and Russian central bank efforts to decouple the Rubal no materialized too. Finally results revealed that ruble is still might overvalued and chance of further depreciation cannot be ruled out.

The study of Yin & Ma, (2018) concluded that crude price plays a major role in affecting exchnage rate after but not before financial crisis period. Further, crude oil market has significant causal effect on exchange rate especially since 2008 subprime crisis. The study used VAR and Monte Carlo approach to build model to find causal effect on exchnage rate. Finally, study concluded that crude oil price fluctuation has causal impact on exchnage rate but frequency of volatility is time varying.

The study of Li, Zhou, & Wu, (2017) based on Bayesian MCMC approach concluded that volatility persist in both oil price and exchnage rate returns. Further, results revealed that there is a jump spillover effect between crude oil price and exchnage rates and that mainly due to major economic events and jump spillover magnitude are very large.

Tiwari & Albulescu, (2016) study concluded that there was a significant co-movement post Indian reform period. Further, Granger causality test statistics suggested that exchnage rate influence crude price in long run and rejected a possibility of short run causality. On the contrary, oil price Granger cause exchnage rate in short and volatility transform from oil to exchnage rate significantly.

The study of Aguado, Echebarria, & Barrutia, (2016) investigated the dynamics relationship between crude oil price and exchnage rate in India. The study results concluded that a negative

innovation shock in crude oil price leads to increase in Indian rupee in short term and as result prices of general commodity go down.

Prasad Bal & Narayan Rath, (2015) study based on India and China concluded that there is bidirectional Granger causality between crude oil price and exchnage rate. Further, study reveled that crude oil price fluctuations influence exchange rate irrespective of exchnage rate regime. Finally, GARCH model finding of revealed that there is unidirectional but persistent volatility from exchnage rate to oil price in China.

The study of Babatunde, (2015) concluded that a positive oil price shock leads to depreciate the exchnage rate but not vice versa. On the contrary, a negative oil price shock appreciates exchnage rates and result in lower inflation in the economy like Nigeria. Finally, study concluded that productivity and interest rate differentials appreciate the domestic currency especially in case of crud exporting country like Nigeria.

Fowowe, (2014)study concluded that increase in crude oil price leads depreciation in exchange rate of Rand South African currency. A 10 percent increase in crude oil prices results in depreciation of 1.4 percent in South African rand. Further, findings revealed that volatility transfer from crude oil price fluctuations to exchnage rates. Finally, research findings suggested that increase in crude oil price resulted in shift of wealth from South Africa to OPEC countries.

The study of Tiwari, Dar, & Bhanja, (2013) found relationship by Granger causality test between crude oil price and exchnage rates of India. The study used time domain approach to find the causal relationship between the variables. Further, study found no causal relationship between oil price and exchnage rate but findings suggested that causal relationship between the variables are

frequency dependent i.e. at lower time scale with high frequency, there is no relationship whereas at higher time scale and lower frequency there is a causal relationship. Finally, finding of the studies are purely based on linear and non linear causalities on frequency domain.

Selmi et al., (2012) study on Morocco and Tunisia to compare oil price and exchnage rate volatility between both the countries using GARCH model concluded that relationship of crude oil price and exchnage rate remain unaffected irrespective of country's status either oil importing or exporting. On the contrary, causality relationship of both the variable remain intense in oil importing country than exporting country.

The study of Ghosh, (2011) suggested that increase in crude oil price leads to depreciation of Indian □. Further, study revealed that positive and negative oil price shocks have almost similar magnitude but oil price shock have persistent impact on Indian exchnage rates. Finally, study concluded that a high crude oil price compels India refiners to purchase dollar to purchase crude and leads to depreciation in Indian currency.

The studies of Ghosh, (2011); Tiwari et al., (2013) studied the impact of oil price fluctuation on exchnage rates in India by using wavelet based analysis and GARCH model but the studies of Babatunde, (2015); Bai & Koong, (2018); Fowowe, (2014); Selmi et al., (2012) focused on either developed countries, South Africa economy and Nigeria. But none of the study analyzed any two country's government tenure from the perspective of volatility spillover effect from the crude oil to exchnage rates.

Research Methodology

Data Description

The study is concerned with time varying effect of oil price and terms of tradevolatility to exchnage rate hence study makes use of monthly data over the period of 2009M05 to 2019M05, giving a total of 121 observations. The study period of 10 years, were meticulously chosen based on the timeline of oath taking ceremony of Dr. Manmohan Singh as Indian Prime Minister under UPA-2 government (May 2009 to May 2014) till result announcement of General Election at the end of first term of Modi government (May 2014 to May 2019) under NDA rule.

Monthly data is used for the study because it enables us to provide an opportunity to study intensity and dynamics of volatility relationships and edge out the outliners from the data which helps in smoothing the time series for the purpose of applying econometric tests. Monthly time series data of Brent crude price, exchnage rate and Indian exports to imports ratio were obtained from Federal Reserve Bank of St. Louis database and later time series variables are transformed to log.

Methodology

First of all, to find data insight and to judge the nature of problem, all the time series are plotted on graph and then separate descriptive statistics were calculated for UPA-2 and Modi Government periods. Addition to that, unit root test is performed on all time series for stationarity of variables. Further, the Breusch-Godfrey Serial Correlation LM Test are applied to find serial correlation in the residuals. Finally, an econometric model was developed using generalized autoregressive conditional heteroskedasticity GARCH (1,1) to measure the volatility spill over effect on exchange rates.

Empirical Results

Primary Results

Under UPA-2 government the minimum price of crude oil was just $61/ barrel and later, shoot up to all time high up to $125/barrel in March 2012, since financial crisis*(Fig.1).*This jump of crude price is evident from the fact that after the 2008 financial crisis developed and emerging economies injected liquidity in their market through booster packages that given impetus in recovering global demand and so to the crude prices. On the contrary, crude prices swung high and low and made this commodity volatile between 2011 to 2014. The UPA-2 government witnessed high crude price with range bound volatility since 2009M05 to 2014M05.

Further, Brent crude prices plunged in July 2014 and witnessed a high volatility in prices. Crude price come down from high of $122/barrel to merely $48/barrel within a year between June 2014 and January 2015. In 2014, world witnessed major structural break in crude prices globally due to oil price collapse and the other hand NDA led government formed government in India and Mr. Narendra Modi as Prime Minister who received full majority in General Election.

Modi Government witnessed depreciated crude oil prices from the day oneand this continuedfree fall in oil pricesmade a new low since 2005 and oil price touched $31/barrel by January2016 that helped India to cut down its crude import bill. The Global economies especially oil producing countries group OPEC called upthe meeting to cut down production to support the falling crude prices but this gesture had not given any respite to the falling prices.

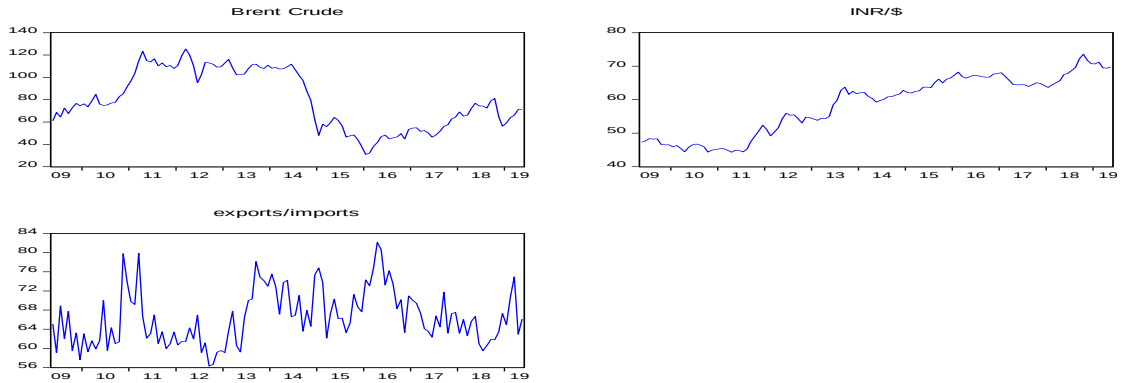
As *Fig.1* shows that Crude price had seen late recovery in prices since July 2017 onward as consensus formed between OPEC and non-OPEC countries like Russia on cutting down crude

production. This consensus on production cut given respite to falling crude prices but remain short lived as burgeoning pressure from U.S. made prices to fall again and made the crude worst performing commodity in term of volatility. Since 20014 to 2017, oil importing countries like China and India enjoyed low crude import bill and as a result, falling transport cost and price of general food articles given central banks confidence to boost liquidity in their country.

On the other hand, Indian □ strengthened against US $ amid increase in crude prices in early 2009 to late 2010 but as the crude price shoot up in the beginning of 2011, □ started depreciating against US $. (*Fig.1)*Indian rupee breached the □ 60/$ level in the early 2014 amid global volatility due to oil price collapse of 2014. The oil price collapse of 2014 dropped the oil prices significantly and resulted in appreciation in □ against $.Finally, crude and Indian exchange rate remain volatile and seems to have a negative correlation with each other as evident form *Fig.1.*

The volatility in □ against $ is also evident from the ratio of export to import graph *(Fig.1).* fall in crude prices given significant jump to export to import ratio between 2011-12 and vice versa in 2012-13. Oil price collapse and the Modi government led FDI (Foreign Direct Investment)

Figure 1*Brent_crude, Exchange Rate ($/□) and Ratio of Exports to Imports since M052009 to M052019*



reforms boosted the export therefore, export to import ratio increased above 80 in the mid of year 2016. Additionally, export to import ratio remain volatile between 2016 to 2019 due to global slowdown and trade war between US and China.

Table 1 *Summary Statistics UPA-2 period*

Sample: 2009M05 2014M05

	BRENT_CRUDE	INR_$	EXPORTS_IMPORTS
Mean	98.89784	51.38444	65.15244
Median	107.9600	49.18732	63.22320
Maximum	125.4455	63.74619	79.86743
Minimum	61.03000	44.30095	56.29854
Std. Dev.	17.61347	6.104594	6.035982
Skewness	-0.643129	0.573301	0.778582
Kurtosis	1.970147	1.999523	2.629881
Jarque-Bera	6.900774	5.885613	6.511116
Probability	0.031733	0.052718	0.038559
Sum	6032.768	3134.451	3974.299
Sum Sq. Dev.	18614.06	2235.964	2185.985
Observations	61	61	61

The descriptive summary statistics of UPA-2 (*Table 1)*period shows that average price of Brent crude between 2009m05 to 2014m05 was at $98.90/barrel whereas median price remain at $107.96/barrel. On the contrary, the difference between maximum and minimum price of crude oil were $64/barrel, as maximum and minimum price of crude were $125.44/barrel and $61.03/barrel respectively. The descriptive study revealed that crude price gained almost 200 percent from its low to its maximum and standard deviation as high as 17.61 which signifies the crude price volatility in the global market.

Indian exchange rate lies between 44.30/$ to 63.74/$ but average exchnage price was 51.38/$. Indian exchnage rate shoot up by around 43% from its low during pre-Modi government period. The standard deviation in exchnage rate was 6.10 which is low in comparison to oil price.

The ratio of Indian exports to imports was as high as 79.86 in comparison to its low of 56.29. Addition to that, average exports to imports ratio was 65.15. Higher the exports to imports ratio or if greater than 100 is always favorable for a country's GDP. Indian exports to imports ratio was worrisome for the economy.

Both the time series of exchnage rate and exports and imports ratio are positively skewed whereas Brent crude time series is negatively skewed. The kurtosis results indicated that all series are platykurtic as kurtosis<3. Finally, Jarque-Bera statistics shows that all series are not normally distributed as Probability value (P<5%) except exchnage rate.

Table 2 *Summary Statistics Modi Government Period*

Sample: 2014M06 2019M05

	BRENT_CRUDE	INR_$	EXPORTS_IMPORTS
Mean	60.53841	65.91852	67.90656
Median	57.03452	65.95877	67.01784
Maximum	111.7952	73.56957	82.17004
Minimum	30.98095	59.73667	59.52015
Std. Dev.	17.09846	3.102394	5.066007
Skewness	0.996128	0.216416	0.730525
Kurtosis	4.019997	2.688591	3.045288
Jarque-Bera	12.52370	0.710797	5.341801
Probability	0.001908	0.700894	0.069190
Sum	3632.305	3955.111	4074.393
Sum Sq. Dev.	17249.09	567.8662	1514.201
Observations	60	60	60

The summary statistics of Modi government period *(Table 2)* indicated that crude oil prices remain volatile during this period as difference in maximum and price was more than 350 percent. But average price remains $60.5/barrel which is lower against the UPA-2 period. The standard deviation is two high but also lower than the UPA-2 period which means oil price remain volatile during this period.

Exchnage rate average price was 65.91/$ with a standard deviation of 3.10. This signifies that exchnage rate time bound uncertainty prevailed in market during Modi Government. Exports ratio to imports increased significantly in Modi Government as average, minimum and maximum prices stand at $67.90, $59.52 and $82.17 respectively.

All the time series are positively skewed and kurtosis results indicated that exchnage rates are platykurticas kurtosis<3 but crude price and exports to imports ratio are leptokurtic as kurtosis>3. Finally, Jarque-Bera test statistics indicate that all time series are normally distributed except Brent crude.

Both the summary statistics results revealed that oil prices remain volatile in both the period of UPA-2 and Modi government and Indian depreciated more against $ in Modi government in comparison to UPA-2. This depreciation in currency may be due to 2014 crude oil price collapse that resulted oil price uncertainty and strengthening the US $. The ratio of exports to imports increased significantly in Modi Government against the UPA-2 because of low price crude import and increase in FDI and exports.

Unit Root Test

Table 3 *Unit Root Test Statistics*

Variables	ADF Test Statistics			
	First Difference Sample 2009M05 to 2014M05		First Difference Sample 2014M06 to 2019M05	
	Intercept	Trend & Intercept	Intercept	Trend & Intercept
DLog(brent_crude)	-7.721014	-7.779318	-5.806101	-6.054045
P-Value	0.0000	0.0000	0.0000	0.0000
DLog(inr_$)	-5.496521	-5.483152	-6.357342	-6.363027
P-Value	0.0000	0.0002	0.0000	0.0000
Log(exports_imports)	-3.796495	-4.133907	-4.173245	-4.440475
P-Value	0.0049	0.0096	0.0016	0.0040

The unit root test results of both the sample periods concluded that all the time series are first difference stationery at 5 percent significance level as P-Value<5% except log(export_import) as this time series are stationary at levels.

Diagnostic test results

Volatility model application asked to ensure that time series mustbe free from serial correlation and should be normal before applying the models. Therefore, Breusch-Godfrey Serial Correlation LM test and Jarque-Bera test of Normality have been applied to ensure the same.

Test result for UPA-2 period

Table 4 *Breuch-Godgrey Serial Correlation LM Test*

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.872673	Prob. F(2,55)	0.0651
Obs*R-squared	5.674850	Prob. Chi-Square(2)	0.0586

Test Equation:

Dependent Variable: RESID

Method: Least Squares
Sample: 2009M06 2014M05

The LM Test statistics for UPA-2 shows that probability value is significant at 5 percent i.e. P<5% hence there is no serial correlation in the model. Further, Jarque-Bera statistics shows that P value is greater than 5 percent (P=0.265>5%) hence, model is normally distributed.

Test result for Modi Government Period

Table 5 *Breush-Godfrey Serial Correlation LM Test*

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.321118	Prob. F(2,55)	0.2752
Obs*R-squared	2.750313	Prob. Chi-Square(2)	0.2528

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 2014M06 2019M05

The LM test statistics for Modi Government period shows that there is no serial correlation in model as P value is greater than 5 percent. Further, Jarques-Bera P value of the model is 0.85 which is greater than 5 percent hence model is normally distributed.

Volatility Results

The financial literature review suggests to use GARCH (GeneralizedAutoregressive Conditional Heteroskedasticity) model to measure the impact of volatility. This model was developed by Bollerslev in 1986 and this an extension to ARCH(Autoregressive Conditional Heteroskedasticity) econometric model. This model incorporates a moving average component together with the autoregressive component.

UPA-2 Period

The GARCH model for UPA-2:

$$GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)$$

Table 6 *GARCH Model Test Statistics UPA-2*

Dependent Variable: DLOG(INR_$)
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Sample (adjusted): 2009M06 2014M05
Included observations: 60 after adjustments
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.060907	0.041381	-1.471851	0.1411
DLOG(BRENT_CRUDE)	-0.143996	0.016149	-8.916464	0.0000
LOG(EXPORTS_IMPORTS)	0.014094	0.009761	1.444012	0.1487
Variance Equation				
C	7.37E-05	2.83E-05	2.601299	0.0093
RESID(-1)^2	1.681784	0.393080	4.278474	0.0000
GARCH(-1)	-0.042287	0.018044	-2.343561	0.0191

R-squared	0.055671	Mean dependent var	0.003751
Adjusted R-squared	0.022537	S.D. dependent var	0.022329
S.E. of regression	0.022076	Akaike info criterion	-5.046902
Sum squared resid	0.027778	Schwarz criterion	-4.837467
Log likelihood	157.4071	Hannan-Quinn criter.	-4.964980
Durbin-Watson stat	1.208582		

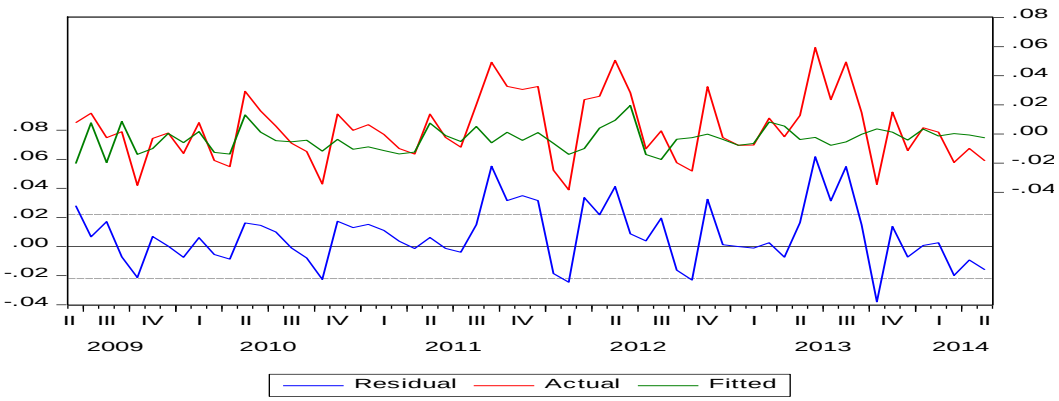
The GARCH model test statistics*(Table 6)* indicated that equation coefficient is not significant at 5 percent level of significance as P-value>5% but Brent_Crude is significant as P-value is 0.0000<5%. This means that there is aspill over volatility effect from crude oil to Indian exchange rates that results in form of higher price uncertainty. On the contrary, ratio of Indian exports to imports is not significant at 5 percent level this means that this ratio did not contribute to exchange rate volatility. The equation model results disclosed that volatility in crude prices had the only factor responsible for spill over effect in Indian exchange rates.

Further, variance equation (*Table 6*) revealed that residual variance of the equation model having ARCH effect as the p-value is less than 5 percent (P-value=0.0000<5%). All residual of the equation model variance is changing over the time frequently that leads to an ARCH volatility in the residuals.

Additionally, GARCH (1,1) equation (*Table 6)* having a negative coefficient and a significant P-value at 5 percent level of significance (P-value=0.0191<5%). GARCH is an extension of ARCH model which incorporates moving average too along with the autoregressive term. GARCH model moving average component allow the model to incorporate both model the conditional change in variance over time and changes in time dependent variance.

Finally, the GARCH (1,1) statistics gives a confirmatory evidence that UPA-2 period was influence by ARCH and GARCH volatility in exchange rates that was the spill over effect only from crude oil price volatility alone but not from Indian ratio of exports to imports.

Figure 2 *Residual Volatility*



From the (*Figure 2*) the residual volatility this is evident that residuals are having an ARCH volatility which means that low volatility period is just proceeded by the high volatility period. Further, the residual volatility graph shows that residual volatility was low between 2009 to 2011

but later residual variance remained highly volatile during the UPA-2 period. The major time varying volatility contribution came from crude oil price fluctuation but not from ratio to exports to imports.

The Modi Government Period

The GARCH Model for Modi Government

$$GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)$$

Table 7 *GARCH Model Test Statistics Post Modi Government*

Dependent Variable: DLOG(INR_$)
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Sample: 2014M06 2019M05
Included observations: 60
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.171103	0.021783	7.854890	0.0000
DLOG(BRENT_CRUDE)	-0.014620	0.013607	-1.074477	0.2826
LOG(EXPORTS_IMPORTS)	-0.039833	0.005150	-7.734867	0.0000
Variance Equation				
C	2.92E-06	7.79E-06	0.374882	0.7077
RESID(-1)^2	-0.160171	0.128623	-1.245283	0.2130
GARCH(-1)	1.163667	0.194518	5.982298	0.0000

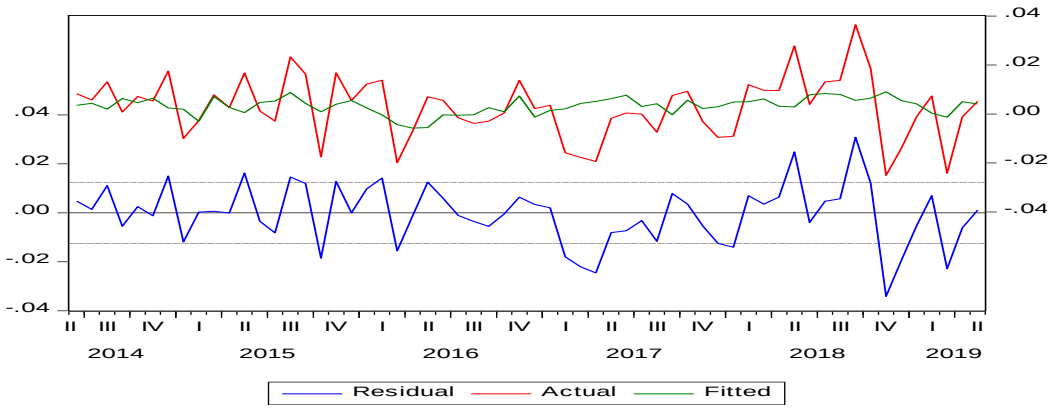
R-squared	0.041483	Mean dependent var	0.002726
Adjusted R-squared	0.007851	S.D. dependent var	0.012474
S.E. of regression	0.012425	Akaike info criterion	-6.030625
Sum squared resid	0.008800	Schwarz criterion	-5.821191
Log likelihood	186.9188	Hannan-Quinn criter.	-5.948704
Durbin-Watson stat	1.634446		

The GARCH model test (*Table 7)*statistic's first half of equation model indicated that equation coefficient is significant at 5 percent level of significance as P-value<5%. The test statistics suggested that Brent_Crude is not significant at percent hence there is no volatility generating from Brent crude to Indian exchnage rate during the Modi government period but on the contrary,

Indian exports to imports ratio made a spillover effect on the exchnage rate as equation coefficient is less than percent. Finally, from the first half of equation model this is evident that only exports to imports ratio could make any volatile effect to exchnage rate during 2014M06 to 2019M05.

The second half of equation model equation (*Table 7*) revealed that model residuals are not having time varying variance which is a confirmatory evidence of no ARCH effect in the model. Moreover, GARCH (1,1) results suggested that residual is having a GARCH effect because GARCH coefficient u under variance equation is significant at 5 percent level of significance.

Figure 3 *Residual Volatility*



The residual graph (*Figure 4*) under Modi government period have shown no sign of volatility from since 2014M05 to 2016M05 but later volatility started to increase and picked up its peak in 2018. The oil price collapse has not contributed to any volatility spillover but volatility contributed by ratio of exports to imports especially from 2017 onwards.

The comparative study of volatility spillover of both the period of pre and post Modi government have given contradictory results as in former only crude oil price have contributed to the volatility in exchnage rates and in later by the ratio to exports to imports only. The UPA-2

government period witnessed the both ARCH and GARCH effect in the residuals volatility which may be due to the spillover effect of the 2008 financial crisis that made crude oil price most volatile globally.

Further, Modi Government period was exposed to GARCH volatility only that was generated because of terms of trade between exports. Oil price collapse and global oil production uncertainty have shown a spillover effect on the imports made by the India as on one hand crude imports become cheaper but on the other demand from the middle east and the west were low that hit the exports revenue.

Conclusion

In this paper we investigated the effect of volatility spillover on exchnage rates due to fluctuations in crude price and terms of trade. Further, we compared the volatility during the UPA-2 Government period and the Modi Government and compared the both tenures to identify the cause of volatility in exchnage rates. To measure the volatility GARCH (1,1) model is used and to find volatility spillover effect in the model residuals in the long run.

The finding of the study revealed that UPA-2 Government regime was exposed to ARCH and GARCH volatility which was contributed by the crude oil price fluctuations and global uncertainty due to lingering effect of 2008 financial crisis. The ratio to export to imports did not impact the residual variance in long run and exchnage rates remained immune to exposure from Indian terms of trade.

On the contrary, Modi Government regime was exposed to GARCH volatility in exchnage rates that was contributed by Indian ratio to exports to imports but not by crude oil prices. The study

findings during 2014M06 to 2019M06 are evident as there was an oil price collapse in 2014 that made imports bill cheaper for oil importing countries. Modi regime was only exposed to exchnage rate volatility in later half of the regime that may due to lingering effect of oil price collapse and production uncertainties globally but that study is out of the scope present study therefore, we leave it to future researchers.

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