Effect of fall in crude oil price on stock indices and exchange rates of India and China.

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Abstract

The present study makes an attempt to investigate the effect of sharp continuous falling crude oil prices on stock market indices and exchange rates of India and China. The period of the study spans from July 2009 to May 2016. Multivariate cointegration techniques along with vector error correction mechanism, impulse response functions are employed in this empirical research .

Keywords: crude oil prices; new oil price shock; stock indices exchange rates.

JEL code: M210

1 Motivation of the Study

Global crude oil prices have experienced a continuous and steady decline particularly over the last twelve months, leading to a noteworthy revenue deficit in many crude oil exporting nations, while for consumers in many crude oil importing countries lower crude oil price means paying less to heat their homes or drive their cars. But cheap oil, at its lowest price in over a decade, is also having far-reaching and unexpected geopolitical and economic consequences around the world. For example, the oil-price plunge causes severe problems for Iraq. Iraq depends on oil for 95 percent of its budget, meaning price drops can affect everyone and everything. Lower oil prices cause's difficulties in Iraq's military campaign against Islamic State (IS) militants, who took over a section of western and northern parts of the country. In terms of Iraq's challenging attempt to turn back IS, less cash obstruct Baghdad's ability to buy military equipment, pay its security forces, and rebuild cities that have been re-conquered from IS fighters (www.rferl.org/content/falling-oil-prices-impact-russia-saudi-arabia-iran-iraq/).

Brent crude oil was recorded at a new low of $28.94 per barrel (as on January 10, 2016) and WTI (West Texas Intermediate) crude is down to below $29.44 per barrel (as on February 7, 2016). Simultaneously, demand for crude oil has plummeted throughout the globe and especially in Asia where the bigger economy and energy consumer, China, is undergoing the slowest economic growth in a decade. According to the analysts, the reasons for this sharp decline in oil prices are two-fold - weak demand in many countries due to insipid economic growth, coupled with surging US production. They are of the opinion that the enormous US storage project is the main cause for falling WTI crude. The huge storage project means that even if US production falls in 2016 as drillers surrender to low prices, it will take several months to work down excess supplies (www.ibnlive.com/news/business/global-crude-oil-price-crash/1186520.html). Added to this is the fact that the OPEC (Organization of Petroleum Exporting Countries) has declared not to cut production as a way to support up prices (www.bbc.com/news/business/29643612). Keeping in tune with these decisions taken by the United States and OPEC, Russia, the second largest producer of crude oil only next to Saudi Arabia also decided not to cut production in order to shore up oil prices. But, the actual fact is that there is an apprehension amongst the oil producing nations that if these oil producing countries like Russia, United States, Brazil and member countries of OPEC cut their production they will lose their dominant niche in the market to their competitors.

A number of substantial finance researchers have concentrated on the issue of the relationship between oil prices, stock markets and macroeconomic variables like growth rate, employment, inflation, monetary policy, etc. Authors like, Loungani (1986), Brurbridge & Harrison (1984) and

Mork (1989) shows that nonlinear relationship exists between economy and the oil prices. Barnanke, Gertler & Watson (1997), Sadorsky (1999), Papapetrou (2001), Barsky & Kilian (2001), Lee & Ni (2002), Hamilton & Herrera (2004), Yang & Bessler (2004), Anoruo & Mustafa (2007), McSweeney & Worthington (2007), Miller & Ratti (2009), and others investigate the impact of oil price shock on stock markets of developed countries. Basher et al. (2010), applies structural vector auto regression model for examining the dynamic relationship between oil prices, exchange rates and stock markets of emerging economies.

The objective of this paper is to examine the dynamic relationship between macroeconomic variables and crude oil price, in the context of continuous fall in the crude oil price in recent times. It may be relevant to point out that the recent shock is different than the previous shocks. Major oil shocks after World War II include Suez Crisis of 1956-57, the OPEC oil embargo of 1973-1974, the Iranian revolution of 1978-1979, the Iran-Iraq War initiated in 1980, the first Persian Gulf War in 1990-91, and the oil price spike of 2007-2008. All these historical oil shocks are associated with increase in crude oil price and its negative effects on the economy. But, the recent fall in oil prices helps in the economic expansion along with falling inflation ("expansionary disinflation") and this situation may persist if oil prices continue to fall bolstering what economists would call a "positive supply shock" (http://www.forbes.com/sites/jonhartley/2016/01/12/the-economic-impact-of-declining-oil-prices-expansionary-disinflation/2/). The recent decline in inflation may be a "supply side" effect associated with the declining price of oil, in the same respect that the surge in oil prices in the 1970's was responsible for soaring inflation. Falling oil prices are also an important part of the recent phenomenon of resurging economic growth in the U.S. Much like how the increase in the price of oil in the 1970's was "a negative supply shock" effectively creating unemployment and declining output, this recent decline in the price of oil is behind a "positive supply shock" in part responsible for the recent boost in economic activity and decline in unemployment in the US (ibid.).

Ono (2011), Ghorbel & Boujelbene (2013) and Morales & Gassie-Falzone (2014) have done something similar studies but have used different data periods and methods for analysis. There are also considerable number of research work like Gisser & Goodwin (1986); Hamilton (2003); Bittlingmayer (2005); Kilian (2008); Kilian & Park (2009) and Fang (2010) that study the effect of increasing oil prices or positive oil price shock on the stock markets and the country's economic health. But, none of them or any other studies have been found to be conducted that evaluate the impact of declining oil prices or negative oil price shocks on the stock markets even during sharp continuous fall in crude oil price in the recent times.

From February 02, 2014 to January 31, 2016, i.e. over the last twenty four months WTI crude oil price has fallen by 103%. The massive supply of crude oil by the oil producing countries throughout the globe continued to pressure markets. The study of Basher et al. (2010), reveal that oil prices react positively to a surprising hike in demand for oil consumption, while it reacts negatively to sudden increase in oil supply. According to Goldman Sachs, volatility in oil price which is at its highest since the collapse of Lehman Brothers in 2008, could reach 100% as storage capacity comes under pressure. Moreover, China, which is the second largest importer of crude oil only next to United States is also experiencing economic slowdown and depressing stock markets, has reduced its import of crude oil.

2. Literature Review

Oil price shocks that originate from the energy markets are defined in various ways. According to Hamilton (2003), oil price shock is an increase in net oil price, i.e. the logarithm change in the nominal price of oil in the current year in relation to the previous years. He argues that oil price shocks may precisely affect short-run economic performance of a country due to its temporary ability to disrupt bulk purchases for consumption and investment goods. The findings of Hamilton are reflected in the earlier study conducted by Gisser and Goodwin (1986) and Darby (1982). Again the study results of Mork (1989) reveal an asymmetric affiliation between changes in oil price and output growth. On the other hand, Kilian (2008a) states that oil price shocks may be demand driven and the nominal oil price shocks measured by Hamilton (2003), does not sort out or wiped out the oil price changes caused by the exogenous political actions. Moreover, it cannot be implied that nominal oil shocks necessarily includes corresponding real oil price shocks. So, in order to overcome these problems, Kilian (2009) employs vector auto regression (VAR) by using real oil price, oil supply and a proxy variable for measuring global demand for industrial commodities as three variables.

Basher et al. (2010), applies six-variable SVAR model and impulse response functions to find out the affiliation between oil price shock, exchange rates and stock markets of the emerging countries. Their study results reveal that oil prices react positively to a surprising hike in demand for oil consumption, while it reacts negatively to sudden increase in oil supply. Bittlingmayer (2005) shows that increase in oil price is interrelated with decrease in stock prices. Hamilton (2009) are of the opinion that consistent rise in real oil price during the period of 2002 to 2008 are mainly because of strong and growing demand for crude oil from China, India and other emerging economies. The impact of oil price shock on the stock markets of three BRIC countries, i.e. Russia, India and China have been analyzed by Fang (2010). He uses the model proposed by Kilian and Park (2009) and the study results reveal that oil price shocks and oil specified demand shocks do not have any significant impact on Indian stock markets, whereas these shocks have positive impact on Russian stock markets. Again, in case of China, he finds that oil specified demand shocks alone positively affect the stock markets of China, while oil price shocks has mixed condition on the stock markets of China. VECM and FIML estimations suggest that there exists long-run positive impact of oil prices on the stock prices of these four oil exporting countries and long-run equilibrium readjustments in each stock market take place through changes in oil prices.

Ono (2011) investigates the effect of oil prices on real stock returns for BRIC countries for the period of 1999:1 to 2009:9. Using vector auto regression (VAR) model he found that real stock returns positively respond to some of the oil price indicators for China, India and Russia, but, in the case of Brazil no significant responses are found. Variance decomposition analysis shows that the contribution of oil price shocks to volatility in real stock returns is relatively large and statistically significant for China and Russia. Morales and Gassie-Falzone (2014) examines the volatility spillovers between oil prices and emerging economies like BRIC. The paper investigates the BRIC financial markets and their movements with regards to energy markets (oil, natural gas and electricity) and to US stock returns fluctuations.

Most of the studies on oil price shocks and stock markets concentrate on developed countries rather than putting their attention on emerging economies. Very few studies like Hammoudeh and Aleisa (2004); Hammoudeh and Huimin (2005) and Basher and Sadorsky (2006) examine the relationship between oil prices and stock markets of emerging economies. In general, they are of the opinion that oil price shocks affect stock indices of these emerging countries.

The scan of the above literatures divulges mixed results and the empirical findings show both positive and negative impact of oil prices on stock market indices. However, no study has been found to be conducted to explore the volatility spillovers and dynamic relationship between oil prices and stock price movements of the emerging economies in the wake of sharp continuous fall in crude oil prices in recent times. Therefore, the present study seeks to find out the effect of declining oil prices which is also regarded as "new oil price shock" on the stock markets of these two as well as the exchange rates of these two emerging economies.

3 Data Set and Methodology

For the present study, weekly data of the closing indices of BSE Sensex (stock index of India), Shanghai Composite (stock index of China), exchange rates of INR and CNY with US dollar as well as the closing prices of the crude oil index represented by the WTI (West Texas Intermediate) crude oil prices have been considered. WTI crude oil index is used as a benchmark for world oil markets(figure 1). Data on stock market indices are retrieved from Bloomberg database and the closing indices of all these countries are taken in terms of USD. Because of non-synchronous data we have taken weekly data and to avoid the weekend effect we have chosen Wednesday's closing prices. The total study period spans from 05 July, 2009 to May , 2016. However, it needs to mention that this is the period of post global recession. To determine this period, we have consider reports of Business Cycle Dating Committee of U.S. National Bureau of Economic Research (NBER) as the standard benchmark. According to the Business Cycle Dating Committee of U.S. National Bureau of Economic Research, the global recession begin in December 2007 and ended in June 2009.For better analysis, all the data values are expressed in terms of logs. To analyze the data obtained from different sources as mentioned above, econometric tools like Elliott, Rothenberg and Stock point optimal (ERS) unit root test, Johansen Cointegration Test, Vector Error Correction Model (VECM), and Impulse Response Function have been used.

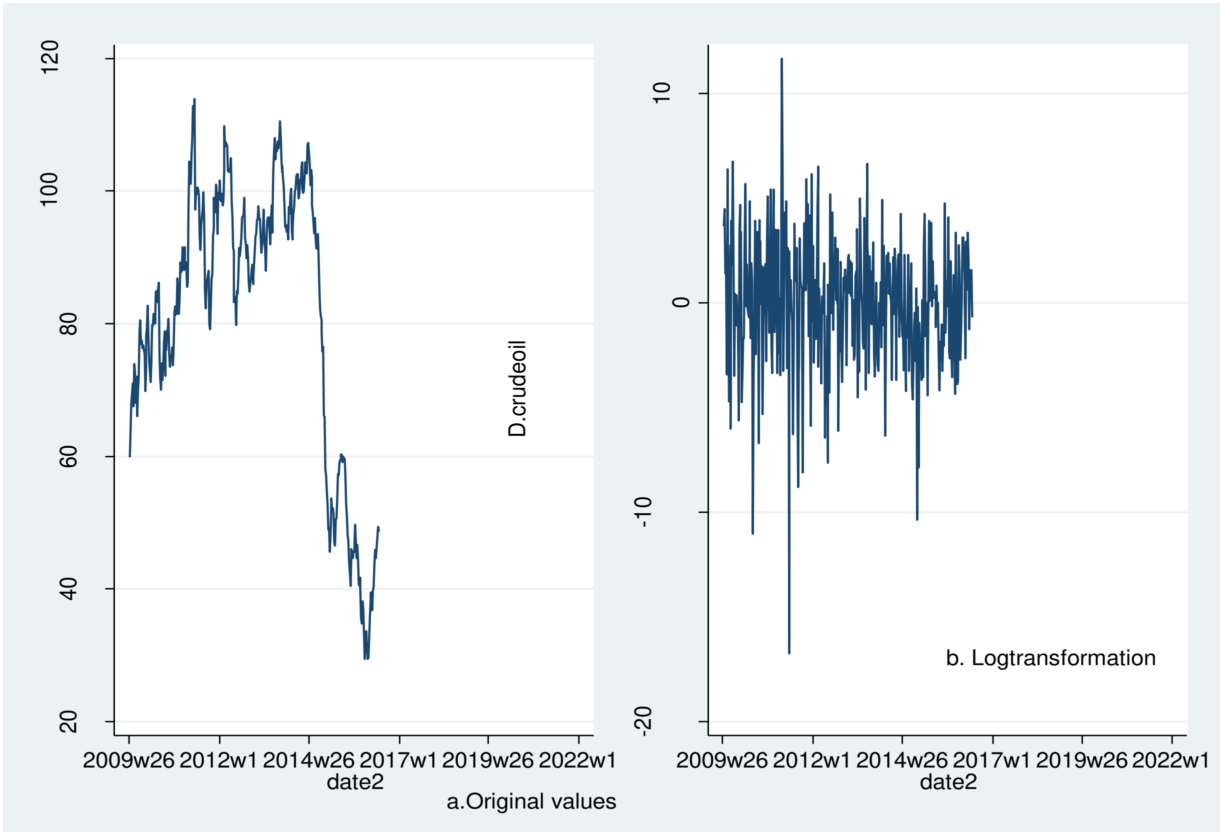

Figure 1: Crude oil price trend (Authors' finding)

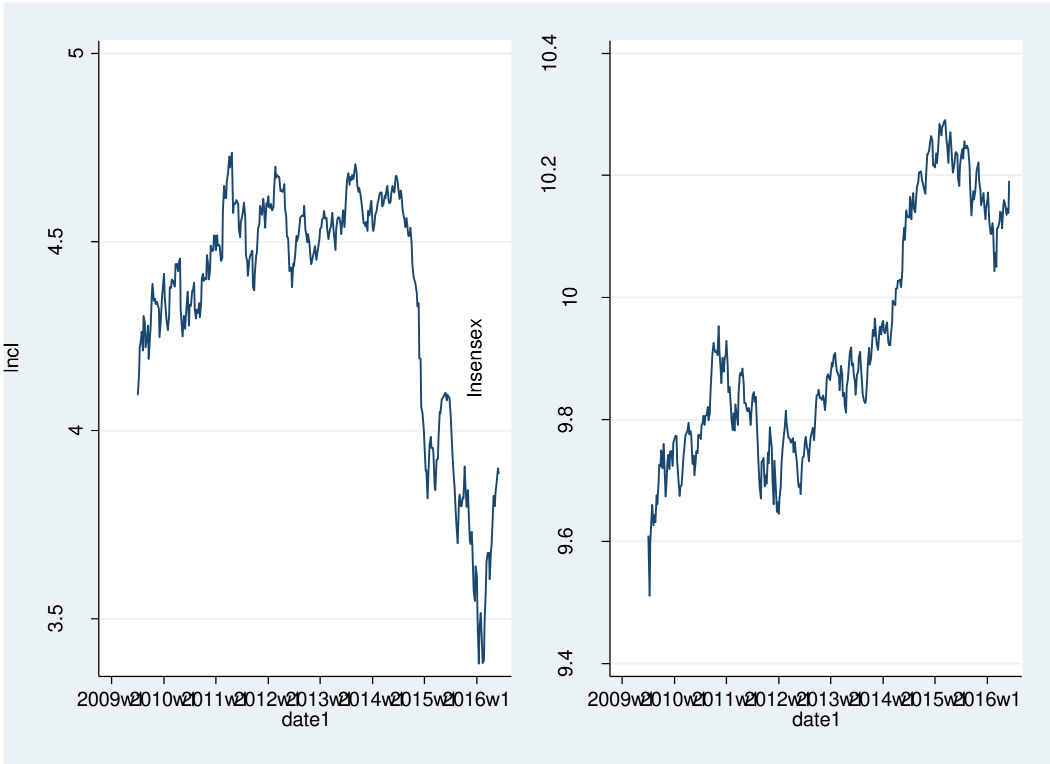

Figure 2: Oil price and Sensex Movements

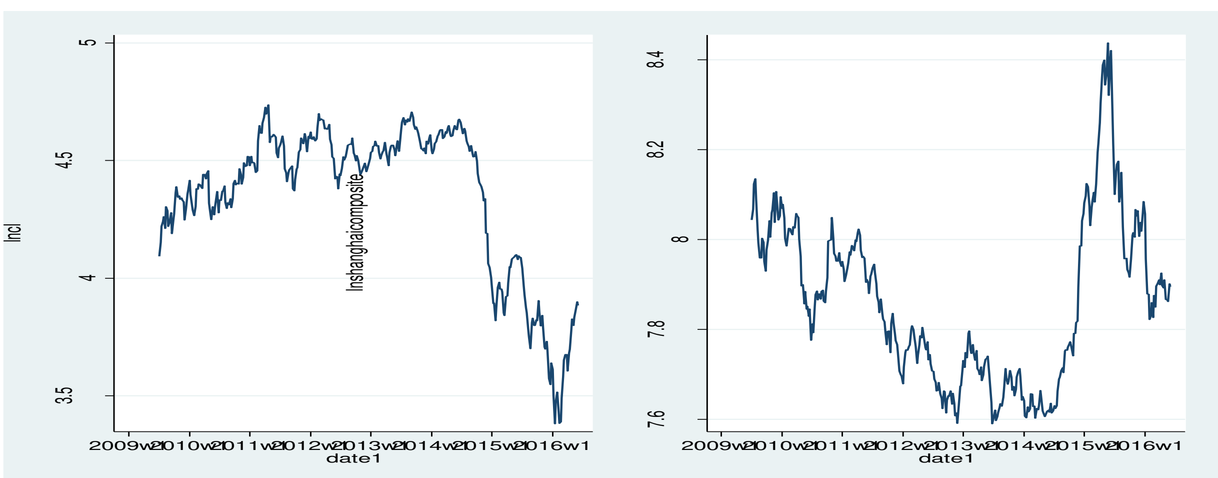

Figure 3: Oil price and Shanghai Composite Movements

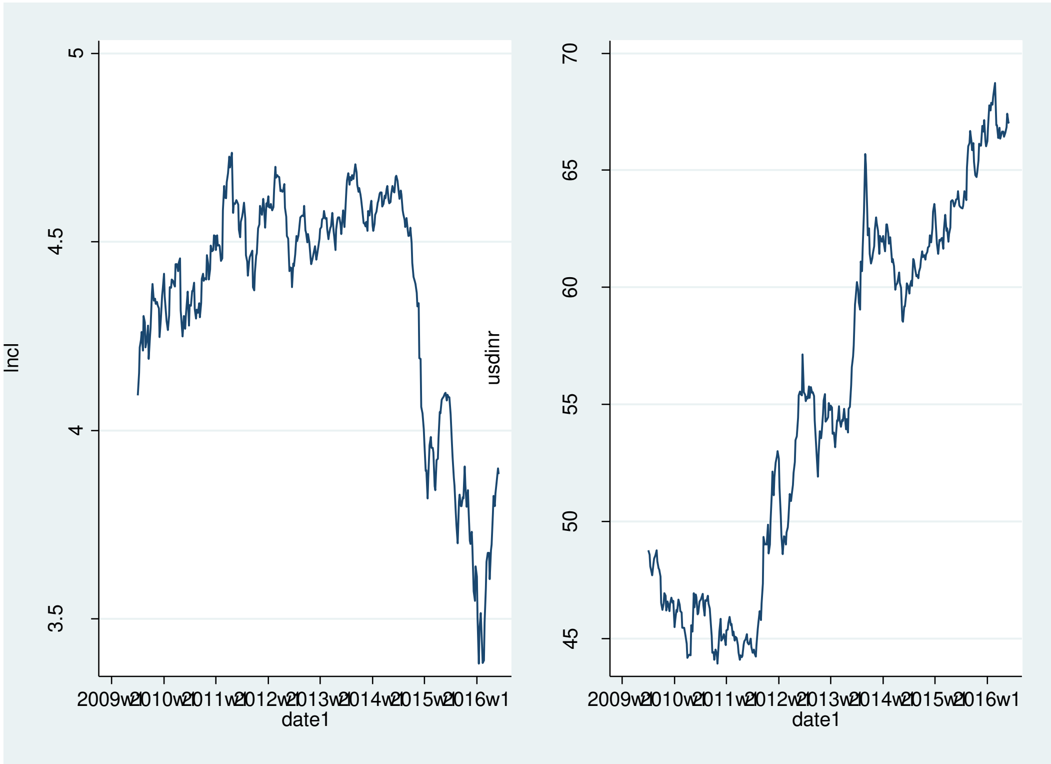

Figure 4: Trends of Oil price exchange rate in India

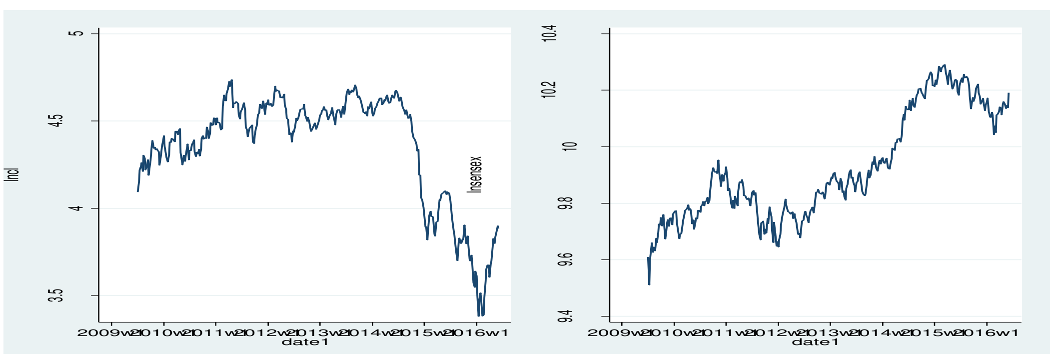

Figure 5: Trends of Oil price Exchange rate in China

4 Results and Discussion

To test for cointegration or fit cointegrating VECMs, we have specified lags by use of varsoc （ Table 1 in Appendix）.

The tests for cointegration implemented in vecrank are based on Johansen's method.
Here we use vecrank to determine the number of cointegrating equations.(Table 2 in Appendix)
Johansen cointegration test provide a mean to determine whether a set of endogenous variables for each of the economies (i.e. for India - BSE Sensex and crude oil price; for China - Shanghai Composite and crude oil price; for India – USD/INR and crude oil price; for China – USD/CNY and crude oil price) have long-run stochastic trend, while allowing for the possibility of short-run divergences.But, no cointegrating equations have been found in case of India, China.

There is no long-term relationship between crude oil prices and stock markets in case of India, China, very short-term relationship may exist along with disequilibrium. Therefore, it is equally important to see whether any adjustments for short-run disequilibrium are made by VECM in case of India, China, The VECM which is first used by Sargan and later popularized by Engle and Granger has cointegration relations built into the specifications so that it restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term is known as the error correction term, since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. In this connection, VECM is applied in this study.
When the impulse is crude oil price the every response of BSE sensex is positive at each time responsive period with a sharp rise in first period the value is approaching to zero. (Figure 6)

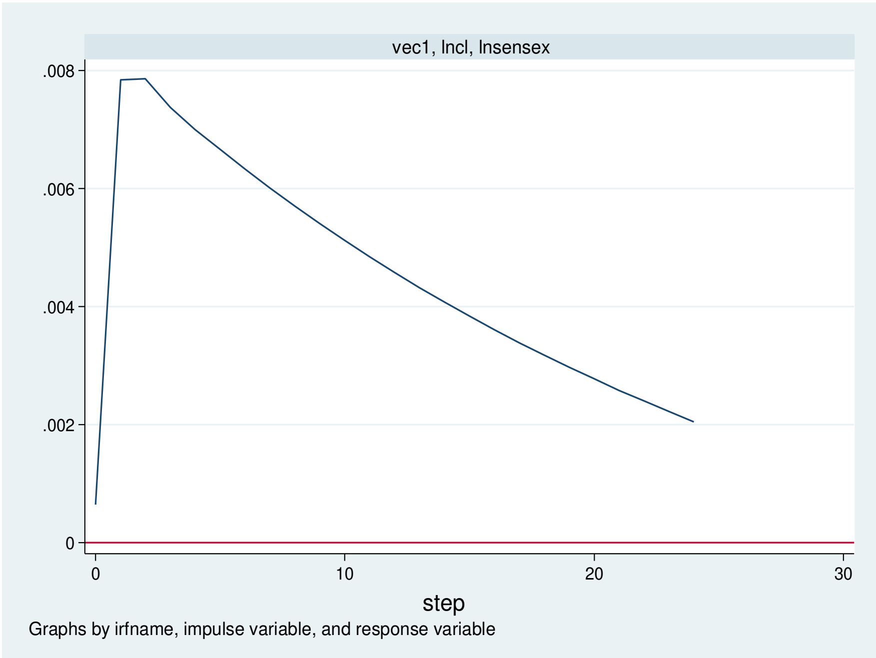

Figure 6: IRF of crude oil and BSE Sensex

When the impulse is crude oil price, we observe the response of USD/INR is v-shaped and for large stretch it is negative.(Figure 7)

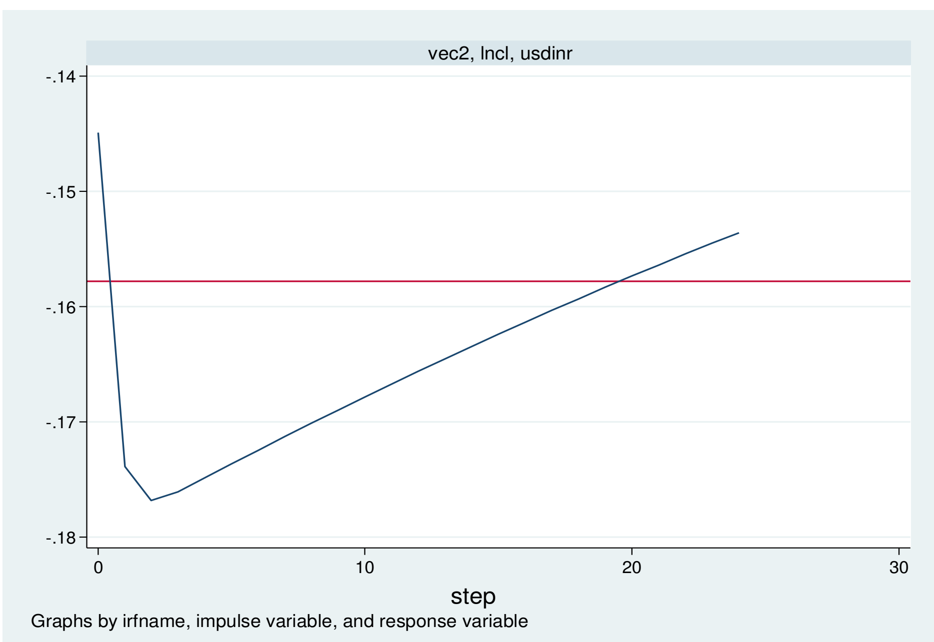

Figure 7

The response of Shanghai composite index is throughout falling and negative in second half.(figure 8)

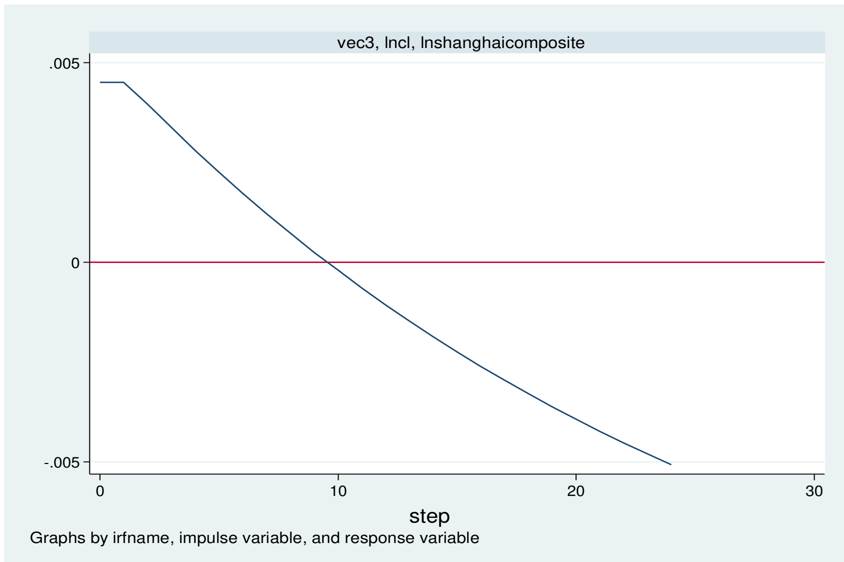

Figure 8

The response of Chinese exchange rate is negative for the entire period of study (Figure 9)

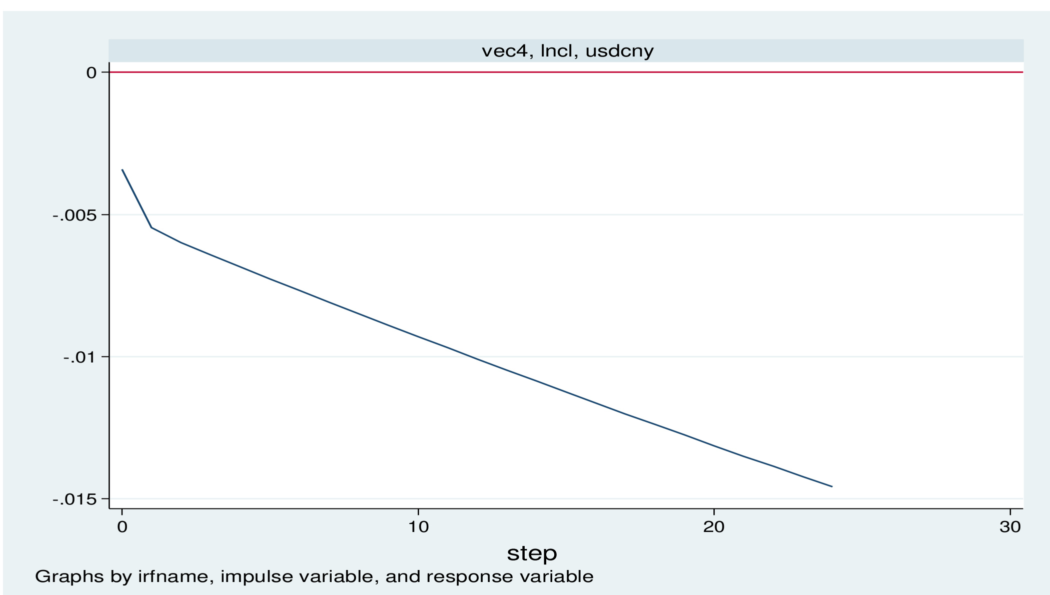

Figure 9

We have used dynamic forecasting to predict the movements of these macro variables. We have observed that the oil price will move smoothly maintaining a constant rate while other variables will show an uptrend in their trajectories.(Figure 10 (a),(b),(c),(d).

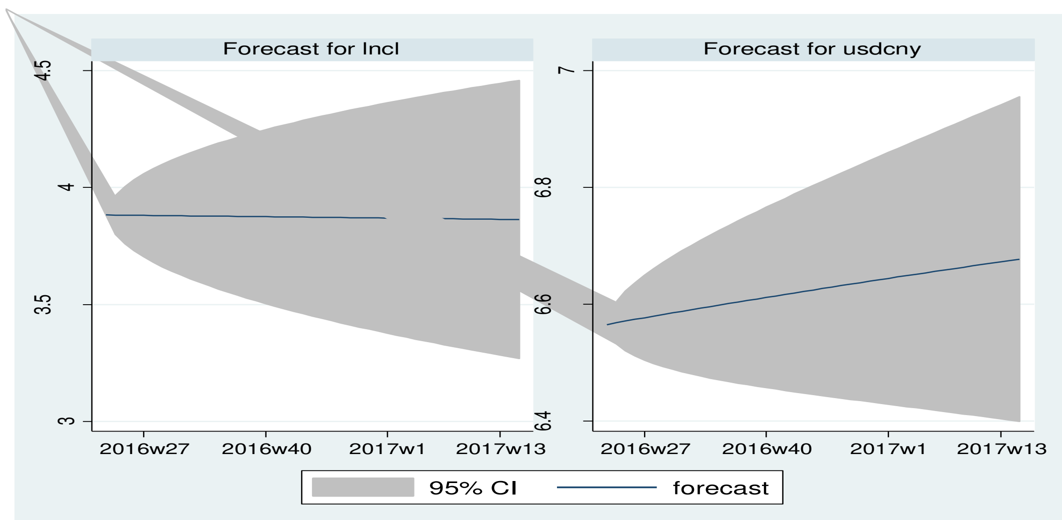

Figure 10(a)

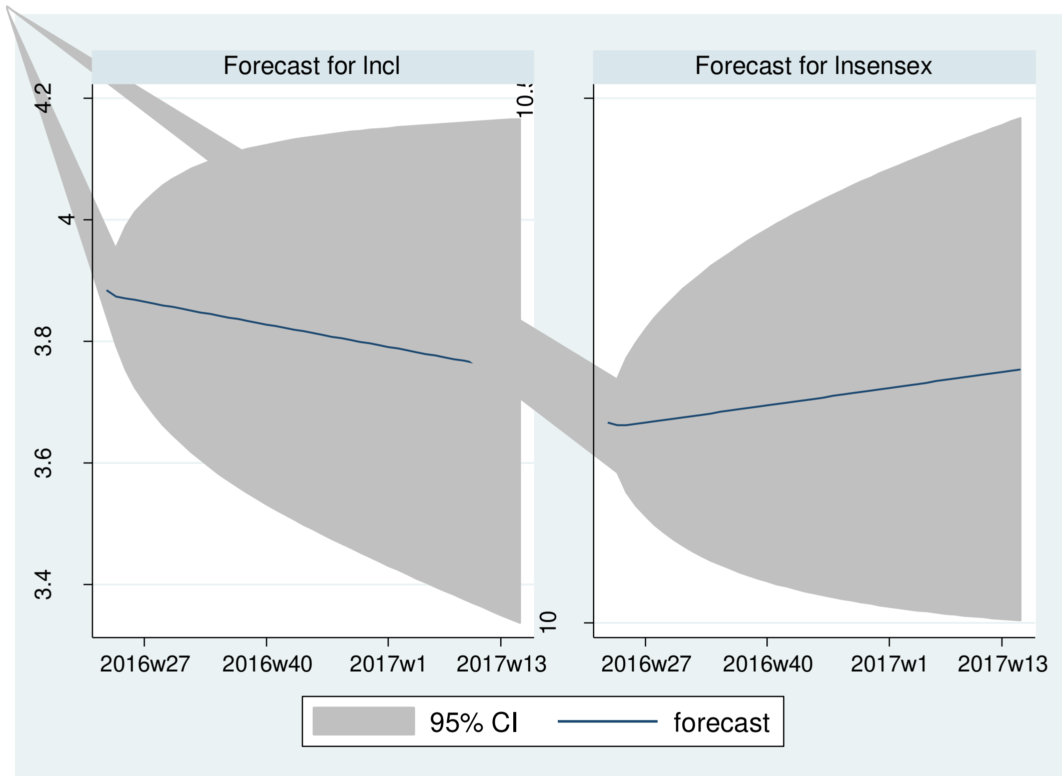
Forecast for lncl
Forecast for lnsensex
4.2
4
3.8
3.6
3.4
10
2016w27
2016w40
2017w1
2017w13
95% CI
forecast

Figure 10(b)

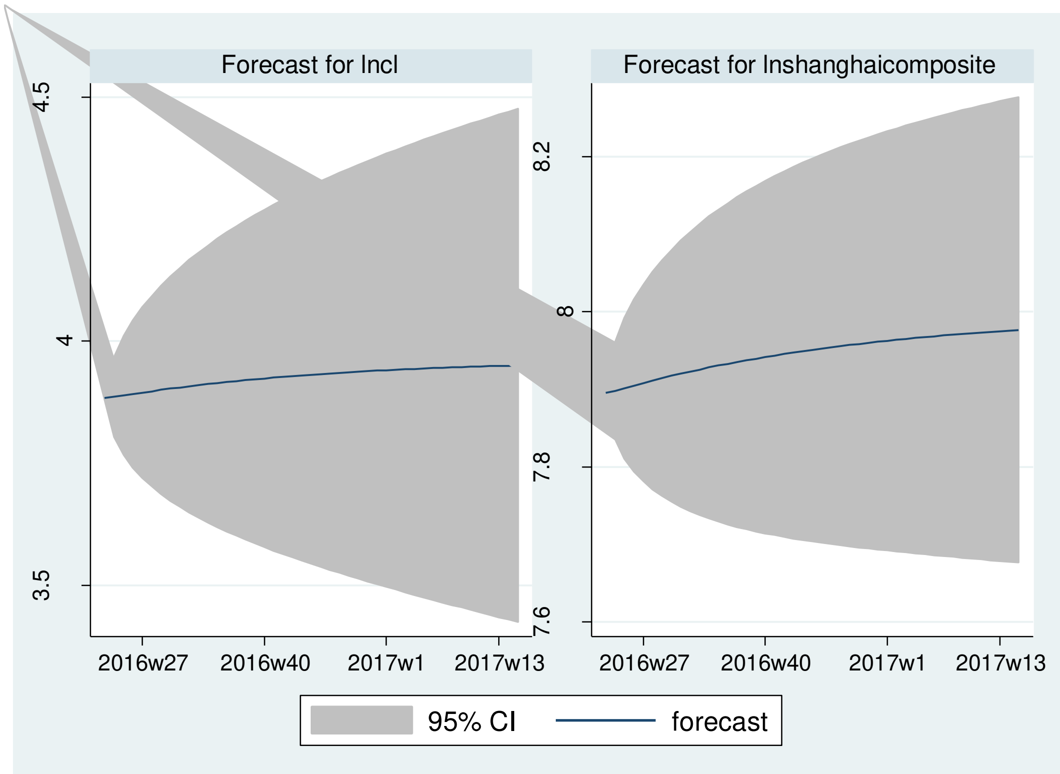
Forecast for lncl
Forecast for lnshanghaicomposite
4.5
4
3.5
8.2
8
7.8
7.6
2016w27
2016w40
2017w1
2017w13
95% CI
forecast

Figure 10(c)

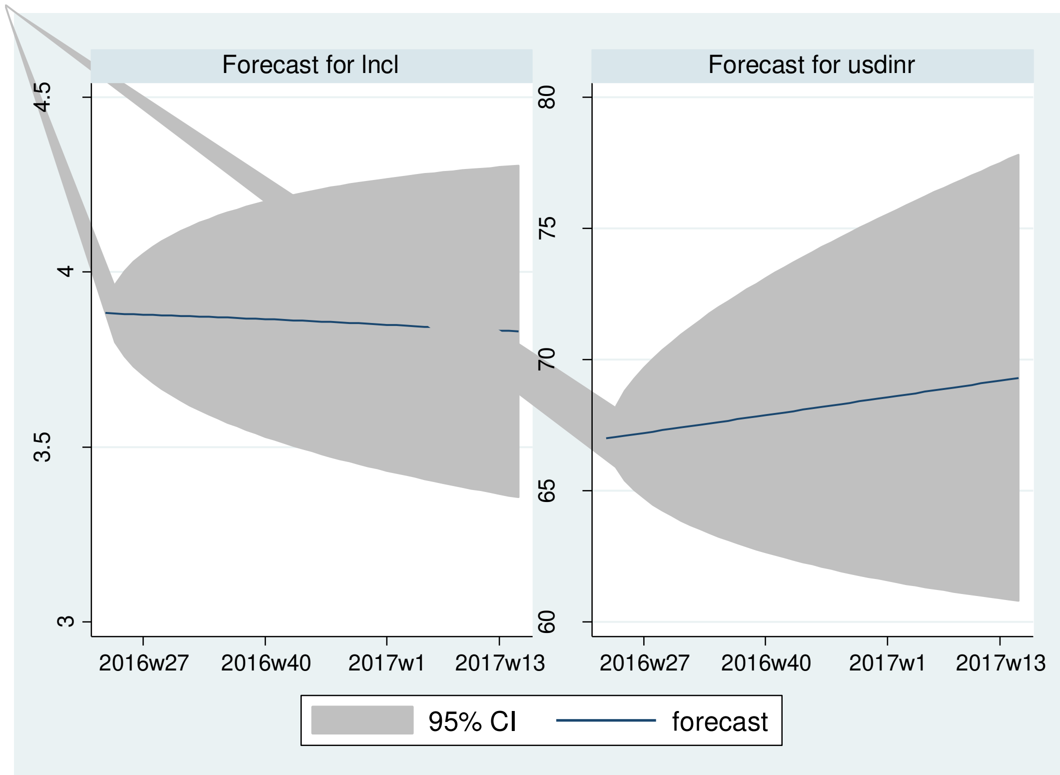

Figure 10(d)

5. Conclusions

This study investigates the dynamic linkages no such relationship has been found in case of other emerging economies like India, China.

In India, BSE Sensex is also somewhat sensitive to changes in crude oil prices although, BSE Sensex does not adjust to innovations in crude oil prices. Shanghai Composite is less susceptible to changes in crude oil prices but, of course in the short-run it adjusts to crude oil price innovations at a moderate speed to correct disequilibrium.

Lower crude oil prices offer an opportunity to commence and carry out serious fuel pricing and taxation reforms in both oil-importing and oil-exporting countries. The resulting stronger fiscal balances would create room for rising priority expenditures and cutting distortionary taxes that boosts up economic growth. Moreover, in a number of low- and middle-income countries, energy sector reforms are being aimed at enlarging the access to reliable energy that has significant developmental advantages (IMF Discussion Note, 2015).

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Appendix

Table1

```
. varsoc lncl lnhangseng

   Selection-order criteria
   Sample:  2009w31 - 2016w23                   Number of obs      =       357
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	265.265				.000784	-1.47487	-1.46623	-1.45315
1	1448.45	2366.4	4	0.000	1.1e-06	-8.08094	-8.05501*	-8.01576*
2	1454.06	11.224*	4	0.024	1.1e-06*	-8.08997*	-8.04676	-7.98135
3	1455.33	2.5408	4	0.637	1.1e-06	-8.07467	-8.01419	-7.92261
4	1457.26	3.8613	4	0.425	1.1e-06	-8.06308	-7.98532	-7.86757

```
   Endogenous:  lncl lnhangseng
    Exogenous:  _cons

. varsoc  lncl lnsensex

   Selection-order criteria
   Sample:  2009w31 - 2016w23                   Number of obs      =       357
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	67.1521				.00238	-.364998	-.356357	-.343274
1	1464.71	2795.1	4	0.000	9.7e-07	-8.17206	-8.14613	-8.10688
2	1482.33	35.233*	4	0.000	9.0e-07*	-8.24834*	-8.20514*	-8.13972*
3	1483.13	1.6021	4	0.808	9.1e-07	-8.23042	-8.16993	-8.07835
4	1484.52	2.7867	4	0.594	9.3e-07	-8.21581	-8.13805	-8.0203

```
   Endogenous:  lncl lnsensex
    Exogenous:  _cons
```

```
. varsoc  lncl  usdinr

   Selection-order criteria
   Sample:  2009w31 - 2016w23                   Number of obs      =       357
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1277.99				4.45961	7.17081	7.17946	7.19254
1	320.602	3197.2*	4	0.000	.000588*	-1.76247*	-1.73655*	-1.6973*
2	323.548	5.8924	4	0.207	.000592	-1.75657	-1.71337	-1.64795
3	325.483	3.8697	4	0.424	.000599	-1.745	-1.68452	-1.59293
4	328.607	6.2496	4	0.181	.000602	-1.7401	-1.66233	-1.54458

```
   Endogenous:  lncl usdinr
    Exogenous:  _cons

.
.
. varsoc  lncl  usdcny

   Selection-order criteria
   Sample:  2009w31 - 2016w23                   Number of obs      =       357
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-83.9053				.005547	.481262	.489903	.502986
1	1549.42	3266.7*	4	0.000	6.0e-07*	-8.64664*	-8.62071*	-8.58146*
2	1552.34	5.8244	4	0.213	6.1e-07	-8.64054	-8.59734	-8.53192
3	1556.7	8.72	4	0.068	6.0e-07	-8.64256	-8.58207	-8.49049
4	1560.91	8.4302	4	0.077	6.0e-07	-8.64376	-8.566	-8.44825

```
   Endogenous:  lncl usdcny
    Exogenous:  _cons
```

Table2

```
. vecrank  lncl lnsensex

                    Johansen tests for cointegration
Trend: constant                                    Number of obs =     359
Sample:  2009w29 - 2016w23                                  Lags =       2
-------------------------------------------------------------------------------
                                                        5%
maximum                                  trace    critical
  rank    parms       LL      eigenvalue  statistic    value
    0      6      1480.0834          .     12.6625*   15.41
    1      9      1486.1033     0.03298      0.6227     3.76
    2      10     1486.4146     0.00173
-------------------------------------------------------------------------------

. vecrank  lncl  lnshanghaicomposite

                    Johansen tests for cointegration
Trend: constant                                    Number of obs =     359
Sample:  2009w29 - 2016w23                                  Lags =       2
-------------------------------------------------------------------------------
                                                        5%
maximum                                  trace    critical
  rank    parms       LL      eigenvalue  statistic    value
    0      6      1355.7295          .      7.5689*   15.41
    1      9      1358.9589     0.01783      1.1101     3.76
    2      10     1359.5139     0.00309
-------------------------------------------------------------------------------
. vecrank  lncl  usdinr

                    Johansen tests for cointegration
Trend: constant                                    Number of obs =     359
Sample:  2009w29 - 2016w23                                  Lags =       2
-------------------------------------------------------------------------------
                                                        5%
maximum                                  trace    critical
  rank    parms       LL      eigenvalue  statistic    value
    0      6      324.05568          .      4.2780*   15.41
    1      9      326.07825     0.01120      0.2329     3.76
    2      10     326.19469     0.00065
-------------------------------------------------------------------------------

. vecrank  lncl  usdcny

                    Johansen tests for cointegration
Trend: constant                                    Number of obs =     359
Sample:  2009w29 - 2016w23                                  Lags =       2
-------------------------------------------------------------------------------
                                                        5%
maximum                                  trace    critical
  rank    parms       LL      eigenvalue  statistic    value
    0      6      1554.0306          .     15.6012    15.41
    1      9      1559.9413     0.03239      3.7799     3.76
    2      10     1561.8312     0.01047
-------------------------------------------------------------------------------
```

Table3

```
. vec  lncl lnsensex

Vector error-correction model

Sample:  2009w29 - 2016w23                        No. of obs      =       359
                                                  AIC             = -8.228988
Log likelihood =  1486.103                        HQIC            = -8.190274
Det(Sigma_ml)  =  8.70e-07                        SBIC            = -8.131634
```

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_lncl	4	.041418	0.0478	17.8101	0.0013
D_lnsensex	4	.022782	0.1068	42.43157	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_lncl						
_ce1 L1.	-.0214533	.0062607	-3.43	0.001	-.033724	-.0091825
lncl LD.	.0785876	.0519023	1.51	0.130	-.0231391	.1803144
lnsensex LD.	-.1153382	.0906709	-1.27	0.203	-.2930499	.0623736
_cons	-.0002333	.0021913	-0.11	0.915	-.0045282	.0040615
D_lnsensex						
_ce1 L1.	-.0024183	.0034437	-0.70	0.483	-.0091678	.0043311
lncl LD.	.1766115	.0285487	6.19	0.000	.1206571	.2325659
lnsensex LD.	-.0317042	.0498732	-0.64	0.525	-.1294539	.0660454
_cons	.0020699	.0012053	1.72	0.086	-.0002924	.0044323

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	1	16.56327	0.0000

Identification: beta is exactly identified

Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_ce1						
lncl	1	.	.	.	.	.
lnsensex	2.175786	.5346175	4.07	0.000	1.127955	3.223617
_cons	-25.93169	.	.	.	.	.

```
. vec lncl lnshanghaicomposite

Vector error-correction model

Sample:  2009w29 - 2016w23                      No. of obs      =        359
                                                AIC             = -7.520662
Log likelihood =  1358.959                      HQIC            = -7.481949
Det(Sigma_ml)  =  1.77e-06                      SBIC            = -7.423309

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
D_lncl               4     .042112   0.0156   5.63169   0.2284
D_lnshanghaico~e     4     .032233   0.0153   5.507529  0.2391
----------------------------------------------------------------

------------------------------------------------------------------------------------
                      |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
----------------------+-------------------------------------------------------------
D_lncl                |
                 _ce1 |
                  L1. |  -.0096113    .006029    -1.59   0.111    -.0214279    .0022054
                      |
                 lncl |
                  LD. |   .0959144   .0531935     1.80   0.071    -.0083429    .2001718
                      |
  lnshanghaicomposite |
                  LD. |  -.0092357   .0699967    -0.13   0.895    -.1464268    .1279554
                      |
                _cons |  -.0001377   .0022512    -0.06   0.951      -.00455    .0042746
----------------------+-------------------------------------------------------------
D_lnshanghaicomposite |
                 _ce1 |
                  L1. |  -.0100556   .0046146    -2.18   0.029    -.0191001   -.0010111
                      |
                 lncl |
                  LD. |   .0067994   .0407147     0.17   0.867    -.0729999    .0865986
                      |
  lnshanghaicomposite |
                  LD. |   .0559994    .053576     1.05   0.296    -.0490076    .1610063
                      |
                _cons |   .0001316   .0017231     0.08   0.939    -.0032456    .0035088
------------------------------------------------------------------------------------

Cointegrating equations

Equation           Parms    chi2     P>chi2
-------------------------------------------
_ce1                 1   9.358695   0.0022
-------------------------------------------

Identification:  beta is exactly identified

                 Johansen normalization restriction imposed
---------------------------------------------------------------------------------
               beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
--------------------+------------------------------------------------------------
_ce1                |
               lncl |          1          .        .       .            .          .
lnshanghaicomposite |   2.440609   .7977936     3.06   0.002     .8769622    4.004256
              _cons |  -23.47694          .        .       .            .          .
---------------------------------------------------------------------------------

.
```

```
. vec lncl usdinr

Vector error-correction model

Sample:  2009w29 - 2016w23                        No. of obs      =       359
                                                  AIC             = -1.766453
Log likelihood =  326.0783                        HQIC            = -1.727739
Det(Sigma_ml)  =  .0005573                        SBIC            = -1.669099

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
D_lncl               4     .042031   0.0194    7.01258   0.1352
D_usdinr             4     .586192   0.0174   6.274664   0.1796
----------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
D_lncl       |
        _ce1 |
         L1. |  -.0142569   .0071707    -1.99   0.047    -.0283112   -.0002025
             |
        lncl |
         LD. |   .0949985   .0541552     1.75   0.079    -.0111437    .2011407
             |
      usdinr |
         LD. |   .0014356    .003918     0.37   0.714    -.0062435    .0091147
             |
       _cons |   .0201437    .010739     1.88   0.061    -.0009044    .0411918
-------------+----------------------------------------------------------------
D_usdinr     |
        _ce1 |
         L1. |    .023558   .1000068     0.24   0.814    -.1724516    .2195677
             |
        lncl |
         LD. |  -.4138509   .7552791    -0.55   0.584    -1.894171    1.066469
             |
      usdinr |
         LD. |   .0858218   .0546422     1.57   0.116    -.0212749    .1929184
             |
       _cons |   .0121906   .1497727     0.08   0.935    -.2813585    .3057397
------------------------------------------------------------------------------

Cointegrating equations

Equation           Parms    chi2     P>chi2
-------------------------------------------
_ce1                 1   3.995174   0.0456
-------------------------------------------

Identification:  beta is exactly identified

                 Johansen normalization restriction imposed
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
        lncl |          1          .        .       .            .           .
      usdinr |   .0399791   .0200016     2.00   0.046     .0007766    .0791815
       _cons |  -5.088774          .        .       .            .           .
------------------------------------------------------------------------------
```

```
. vec  lncl   usdcny

Vector error-correction model

Sample:  2009w29 - 2016w23                        No. of obs      =       359
                                                  AIC             = -8.640342
Log likelihood =  1559.941                        HQIC            = -8.601628
Det(Sigma_ml)  =  5.77e-07                        SBIC            = -8.542988

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
D_lncl               4     .042212   0.0109   3.912468   0.4180
D_usdcny             4     .018508   0.0432    16.0129   0.0030
----------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
D_lncl       |
        _ce1 |
         L1. |  -.0020622   .0070285    -0.29   0.769    -.0158379    .0117134
             |
        lncl |
         LD. |   .0814748   .0538502     1.51   0.130    -.0240696    .1870191
             |
      usdcny |
         LD. |  -.1164337   .1219655    -0.95   0.340    -.3554816    .1226143
             |
       _cons |  -.0006073   .0023123    -0.26   0.793    -.0051394    .0039248
-------------+----------------------------------------------------------------
D_usdcny     |
        _ce1 |
         L1. |  -.0102364   .0030817    -3.32   0.001    -.0162763   -.0041964
             |
        lncl |
         LD. |  -.0406125   .0236107    -1.72   0.085    -.0868885    .0056636
             |
      usdcny |
         LD. |  -.0248759   .0534759    -0.47   0.642    -.1296868    .0799349
             |
       _cons |   .0001223   .0010138     0.12   0.904    -.0018648    .0021094
------------------------------------------------------------------------------

Cointegrating equations

Equation           Parms    chi2     P>chi2
-------------------------------------------
_ce1                 1    3.12588   0.0771
-------------------------------------------

Identification:  beta is exactly identified

                 Johansen normalization restriction imposed
------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_ce1         |
        lncl |          1          .        .       .            .           .
      usdcny |   .6742047   .3813341     1.77   0.077    -.0731964    1.421606
       _cons |   -8.57795          .        .       .            .           .
------------------------------------------------------------------------------

.
```