IMPACT OF CRUDE OIL PRICES SHOCKS IN CHINA, INDIA AND USA ON THE INFLATION

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ABSTRACT

The paper studies Impact of Crude oil on Inflation (CPI) in India, China and USA. Applying Unit Root Test, Co-integration and Vector Error Correction Models (VECM), Vector Auto Regression (VAR) and Granger Causality the econometric research software called EVIEWS 6was used to apply all those tools successfully to data form 1996–2015 and revels that Crude Oil prices has the short term relationship and there is Unidirectional Causality in India. China shows there is positive insignificant short term relationship between the Crude Oil prices and Inflation and USA has no causality but has the positive insignificant short term relationship between Crude Oil prices and Inflation.

***KEYWORDS**: CPI, VAR, VECM, EVIEWS, Crude Oil, Co-integration, Granger Causality.*

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Introduction

India is the exporter of crude oil and it exports up to 80% of its crude oil requirement and also the imports are dollar dominated. The government decided the price of the petrol through administrative price mechanism. It has been seen from 2005 effect of crude oil imports on Inflation. Whenever the Imports increase the Inflation has increase. Oil price affects the entire economy, especially because of its use in transportation of goods and services. A rise in oil price leads to an increase in prices of all goods and services. It also affects us all directly as petrol and diesel prices rise. As a result, inflation rises. A high inflation is bad for an economy. It also affects companies - directly because of a rise in input costs and indirectly through a fall in consumer demand. This is why the fall in global crude prices comes as a boon to India. Every $10 per barrel fall in crude oil price helps reduce retail inflation by 0.2% and wholesale price inflation by 0.5 %(Money control, 2015). In India, oil demand for 2015, rose by 0.22 mb/d (Millions barrels per day), products like LPG, gasoline and diesel shows the gain to the Investors. Macro-economic variables also shown the support to low international oil prices but in China oil demand is fall by 0.05 mb/d and USA by 0.16 mb/d because of lower growth rate. The Fall of Global Oil prices may adversely affects the India, China, USA because it will be adversely affect the export of Petroleum Products. According to US Energy Information Administration USA is the single largest exporter of Petroleum products and China is at third, India is at fifth position. So, these countries will directly affect if Crude Oil prices increase.

The present study tries to analyze the impact of Crude Oil prices on the Inflation of China, India and USA and CPI(Consumer Price Index) is taken as proxy of Inflation and tries to fill the gap of the Literature. Past literature has only studied one country or group of countries (BRICS, NAFTA etc.) but no one has focused on these three countries which are more technologically advanced and has high growth potential.

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Literature Review

- **O'Brien & Weymes, 2010:** This article highlights the distinctive features of the Irish energy market which render the impact of oil price changes on Irish inflation different to the average impact felt at the euro area level taking yearly data of 1995 to 2007 reveals that The direct effects on inflation are stronger in Ireland than in the euro area, reflecting the higher dependence on both oil and gas.

- **Sujit, 2011:** This study shows relationship among Gold price, stock returns, Exchange rate and Oil price. This study takes daily data from January 1998 to June 2011. Using techniques of time series they studies relationship among these variables using vector autoregressive and co integration technique. The results show that Exchange rate is highly affected by stock returns, Exchange rate and Oil price.

- **Qianqian, 2011:** The Paper studies the impact of Oil price fluctuation in China using Co-integration and error correction model using monthly data of 1999 to 2008 and results show that there exist long-run equilibrium relationship between the oil price and the China's output, the consumer price index, the total amount of net exports and the monetary policy.

- **Sek, Teo, & Wonga, 2015:** In this study, empirical analyses are performed to study the effects of oil price changes on inflation in two groups of countries, namely the high versus low oil dependency groups. Study uses the thirty years data ranging from 1980 to 2010 and Used autoregressive distributed lag (ARDL), pooled mean group method and reveal that oil price change has its direct effect on domestic inflation in low oil dependency group but its impact is indirect on affecting the domestic inflation in the high oil dependency group through changes on the exporter's production cost.

- **Gokmenoglu, Azina, & Taspinar, 2015:** This paper investigates the relationship among the oil price, inflation, GDP and industrial production for 1961 to 2012 period in the case of Turkey. Data used in the study was extracted from World Bank Development Indicators and the OPEC. Three different tests, namely unit root, co-integration and causality tests, have been employed to investigate the relationship among the variables Johansen co-integration results confirm a long-run relationship among these variables and Granger causality test illustrates the unidirectional relationship from oil price to industrial production.

- **Ratti & Vespignani, 2016:** Study Investigates the relationship between oil prices, global industrial production, prices, central bank policy, interest rate and monetary aggregate with a global factor-augmented error correction model. This study takes the data from January 1999 to December, 2013 The conclusion is that there is positive innovation in global oil price is connected with global interest rate.

- **Brini, Jemmali, & Farroukh, 2016:** Paper attempts to analyzed the Oil prices shocks effect on Inflation and Exchange rate from January, 2000 to December, 2015 in MENA countries using structural VAR model and results reveals that there is the relationship between Oil prices , Inflation and Exchange rate.

Research Methodology

The Period of the Study is from January 1996 to December 2015.Sample size Contains three countries India, China and USA. The study undertook the secondary data for analysis. The Monthly values of Oil prices taken from US Energy information Administration (oil prices),Reserve Bank of India (CPI) and National Bureau of Statistics of China etc. Statistical Tools and Techniques used are**:**

- **Unit Root Analysis (Augmented Dickey Fuller), (Phillip Perron)**

The ADF Unit root is based on Null Hypothesis Ho: Yt is Not I(0). If the calculated ADF Statistic is less than the critical value, then the null Hypothesis is rejected; otherwise accepted. ADF and Phillip Perronare used to see the stationarity between Crude Oil prices and Inflation.

$$\Delta Yt = \alpha 0 + \alpha 1 Yt - 1 + \sum Y j \Delta Yt - j + Et$$

- **Vector Auto Regression**

VAR Model is used to predict and analyze interrelated time series and dynamic effects that the random perturbations have on the variables system. There is no need to specify whether some variables are endogenous or exogenous. It shows the response of Crude Oil prices and Inflation. It focuses more on the increase or decrease in trend. It is also used to detect the causal relationships among the variables.

- **Johansen Co-integration Test**

The trace statistic can be specified as: Γ Trace

$$= -T \sum \log(1 - \lambda i)$$

Johansen Co-integration Test has been applied to check whether the long run Equilibrium relation exists between the Oil Prices and Inflation. It is based on two test statistic, i.e. Trace Test Statistic and the Maximum Eigen value test statistic.

- **Granger Causality Test**

The **Granger causality test** is a statistical hypothesis test for determining whether one time series is useful in forecasting another. So study helps to determine whether Crude Oil Prices helps to determine Inflation of the Country. A time series Crude Oil Prices is said to Granger-cause Y if it can be shown, usually through a series of t-tests and F-tests on lagged values of Inflation (and with lagged values of Crude Oil Prices is also included), that those Crude oil Prices values provide statistically significant information about future values of Inflation .

$$\hat{t} = \sum_{i=1}^{m} B1 Yt - 1 + \sum_{i=1}^{m} ai Xt - i$$

$$Xt = \alpha 0 + \sum_{i-1}^{m} \alpha i Xt - 1 + \sum_{i=1}^{m} \Lambda i Y t - 1$$

Scope of the Study

Growing variability in Crude Oil Prices in the recent years, validate the need to examine such fluctuation from January 1996 to December 2015.The data for 20 years has been taken for consideration and the three markets are considered i.e. India, China and USA for studying the impact of Crude oil prices on Inflation. In reality Inflation did not solely affected by single factor. In the study, the relationship between the Crude Oil Prices, and Inflation of the countries were being investigated.

Analysis of the Study

Table 1: Descriptive Statistics of Inflation and Oil prices from 1996-2015

Particulars	Inflation			Oil Prices		
	China	India	USA	USA	India	China
Mean	1.9625	1.8729	1.9954378	2.3825	1.647937	0.914845
Std. Dev.	0.914845	0.1669	0.0591	0.5255	0.298477	0.314679
Skewness	0.914845	0.3523	-0.1436	-1.4112	-0.204067	-0.455685
Kurtosis	0.914845	1.9600	1.6532	3.7455	1.772440	1.996587
Jarque-bera	0.914845	15.780	18.96387	85.221	16.73478	18.37432
Probability	0.914845	0.0003	0.0000	0.0000	0.0002	0.0001

Source:-Authors compilation

The above table 1 highlights the Descriptive Statistics of CPI and Crude oil Prices. The Data is converted to logs because of uniformity; It gives information about Mean, Standard Deviation, Skewness and Kurtosis values of the India, China, USA for the period of January 1996 to December 2015.The dependent variable that is Inflation.CPI which is taken as proxy of Inflation rate shows a Highest standard deviation for India i.e. 0.16,Kurtosis shows that India CPI is distributed normally i.e.1.96 which is closer to 3 among other variables.USA oil prices has a Highest standard deviation i.e. 0.52 and kurtosis value of 3.74 which points out that USA oil prices moves negatively at around 1.41 and there is high risk in fluctuation of oil prices because of Inflation.

Table 2: Unit Root Analysis of Crude oil prices and Inflation Rate

Unit Root	ADF		Phillip-Perron	
Null Hypothesis	T- Statistics	Probability	T- Statistics	Probability
Oil price USA has a Unit Root	-10.06745	0.000	-10.108025	0.0000
Oil price India has a Unit Root	-9.765815	0.0000	-9.826013	0.0000
Oil price China has a Unit Root	-12.99907	0.0000	-12.99907	0.0000
CPI of USA has a Unit Root	-9.76	0.0000	-7.42	0.0000
CPI of India has a Unit Root	-11.54	0.0000	-10.69	0.0000
CPI of China has a Unit Root	-15.16	0.0000	-11.32	0.0000

Source:-Authors compilation

Time series data is usually non stationary it will lead to spurious regression. To carry out the co-integration Analysis the first step to check the Stationary So for that Unit Root test i.e. Augmented Dickey-Fuller test (ADF) and Phillip Perron test(PP test) is conducted and found that data is non-stationary at level so the data is converted to the first differenced. Table 2 shows that the data is significant at 1% level (i.e. p value<1%) and become stationary at First differenced so this data can be used to find the Johansen (1998) and Johansen and Juselius (1990) Co-integration for long term relationship.

Co-integration between Crude Oil Prices and Inflation

To find the long term relationship by Co-integration first we have to decide the Lag length criteria by running a Normal VAR so from the VAR the length which is decided as per the Schwarz information criterion (SIC)is order (1) for India CPI and Oil Prices and order (2) for USA CPI and China CPI and Oil Prices. Co-integration tells about there is Long Term Relationship or not for Examining the relationship between the variables Co-integration model has developed by taking the Lag length criteria as per SIC. Johansen Co-integration determines that there the variables are co-integrated or not.so it shows if one variable increases then what will be the effect on other variable. (Tufail, 2013) Co-integration is used to determine the long-run relationship between two or more variables that are individually non-stationary but have a stationary linear combination.

Table 3: Johansen Co-integration between Inflation and Crude Oil Prices

Null Hypothesis Trace rank Test	Alternative Hypothesis	Eigen value	Trace Statistic	Critical values (0.05%)	P-values*
India CPI and Crude Oil Prices					
H_0: r = 0	H_1: r = 0	0.015055	3.607761	15.49471	0.9326
H_0: r = 1	H_1: r = 1	0.000182	0.042869	3.841466	0.8359
USA CPI and Crude Oil Prices					
H_0: r = 0	H_1: r = 0	0.024311	9.214301	15.49471	0.3459
H_0: r = 1	H_1: r = 1	0.014166	3.381388	3.84146	0.0659
China CPI and Crude Oil Prices					
H_0: r = 0	H_1: r = 0	0.026079	6.889715	15.49471	0.5905
H_0: r = 1	H_1: r = 1	0.002889	0.679820	3.841466	0.4096
Max-Eigen Statistic	Alternative Hypothesis	Eigen value	Max-Eigen Statistic	Critical values (0.05%)	P-values*
India CPI and Crude Oil Prices					
H0: r = 0	H: r > 0	0.015055	3.564892	14.26460	0.9022
H_0: r ≤1	H_1: r > 1	0.000182	0.042869	3.841466	0.8359
USA CPI and Crude Oil Prices					
H_0: r = 0	H_1: r > 0	0.024311	5.832913	14.26460	0.5864
H_0: r ≤1	H_1: r > 1	0.014166	3.381388	3.841466	0.4096
China CPI and Crude Oil Prices					
H_0: r = 0	H_1: r > 0	0.026079	6.209820	14.2646	0.6509
H_0: r ≤1	H_1: r > 1	0.002889	0.679820	3.841466	0.2081

Table 3 shows that Johansen Co-integration proposes two tests-the trace test (λtrace) and maximum eigen value test (λmax)- which are used to determine the existence and number of co-integrating vectors. Test shows that critical Value is less than the Trace statistics then we can say that there is a co-integrated equation between the variables. When we find at least one Co-integration then we use VECM Model to known the long term relationship between the variables. The table also shows the critical value is more than the trace value then we can say that there are no co-integrating variables in the equation. Test shows that there is no Co-integration equation between USA, China, India CPI and Crude Oil prices (i.e. p value >0.05) because the critical value is higher than the Trace Statistics or (p value >0.05). When we find no Co-integration then we use VAR Model to known the Short term relationship between the variables.

Table 4: Vector Auto Regression between Inflation and Crude Oil Prices

Particular	USA Oil and Inflation		China Oil and Inflation		India Oil and Inflation	
Independent	Dep. Inflation	Dep.Oil Price	Dep. Inflation	Dep. Oil Price	Dep. Inflation	Dep. Oil Price
	USA 1.269271*	USA 3.373070	China 1.158922*	China 1.367620	India	India
	(0.06667)	(2.95438)	(0.06485)	(1.25027)	1.267715*	-0.561763

Inflation (-1)	[19.0370]	[1.14172]	[17.8696]	[1.09386]	(0.06767)	(0.73417)
	-0.270789*	-2.843236			[18.7344]	[-0.76517]
			-0.275382*	-0.209810	-0.295665*	0.372247
Inflation (-2)	[-4..09822]	[-0.97111]	(0.06222)	(1.19947)	(0.06874)	(0.74585)
	-0.001857***	2.634323	[-4.42602]	[-0.17492]	[-4.30093]	[0.49909]
	(0.00441)	(0.19529)	0.004843	-1.787802	0.003306**	1.163276
Oil price (-1)	[-0.42141]	[13.4895]	(0.00831)	(0.16061)	(0.02120)	(0.23005)
	0.013858***	0.205958	[0.58312]	[-11.1660]	[-0.15590]	[5.05664]
	(0.00689)	(0.30916)	0.011720	-0.208011	0.057633**	-0.225908
Oil Price (-2)	[1.98614]	[0.66618]	(0.01177)	(0..22695)	(0.03323)	(0.36049)
	-0.018284**	0.105800	[0.99551]	[-0.91654]	[1.73458]	[-0.62668]
	(0.02125)	(0.94144)	0.188727	-1.463559	-0.141981*	-0.881582
	[-0.86058]	[0.11238]	(0.04739)	(0.91353)	(0.05568)	(0.60410)
Constant			[3.98269]	[-1.60209]	[-2.54997]	[-1.45932]

*indicates significance at 10% ** indicates significance at 5%

Source:-Authors compilation

Table 5 : Granger Causality Test between Inflation and Oil prices

Null Hypothesis:	Obs.	F-Statistics	Prob.	Decision	Nature of Causality
USA Oil prices does not Granger Cause USA Inflation	238	1.94239	0.1472	Accepted	No Causality
USA Inflation does not Granger Cause USA Oil prices	238	0.32544	0.7225	Accepted	No Causality
China Oil prices does not Granger Cause China Inflation	236	0.29481	0.8812	Accepted	No Causality
China Oil prices does not Granger Cause China Oil prices	236	1.16446	0.3273	Accepted	No causality
India Inflation does not Granger Cause India Oil Prices	236	2.79970	0.0268	Rejected	Causality
India Oil Prices does not Granger Cause India Inflation	236	1.22672	0.3003	Accepted	No Causality

Source:-Authors compilation

Table 5 shows Vector Auto Regression (VAR) between Oil prices and Inflation of China, India, and USA. It shows that in USA as the time goes Inflation are decreasing. It means Inflation are affected by its own past values and also the Crude oil prices Negatively affecting the Inflation In USA. And same phenomenon we can see in India where crude Oil Increases the inflation is also increasing. Crude Oil prices are significant at 5% level in India and USA but it is not affecting the China's economy. Crude Oil Prices Lag (-1) is significant at 1% level shows that today's prices are affected by its past one month prices but for Lag (-2) the today's prices are decreasing and it is accepted at 5 %level of significance in India and USA. The table shows the results of Granger Causality Test between USA, India, China Crude Oil prices and Inflation. The selected lags for USA are Lag (2), China (4), India (4). And If the Probability value is less than 5% then we reject the null hypothesis i.e. There is no Causality between the variables. This test shows that if past values of Oil prices causes the Present Value of Inflation from above table we can conclude that only in India there is Causality between the India's Inflation and Crude oil prices and exits Bidirectional Causality and there is no Causality between USA and China. Its means Crude Oil prices are affecting the inflation in India and also vice versa but this situation is not present in neither in USA nor China.

Conclusion

In this paper we have analyzed the Impact of Crude Oil Prices on Inflation. We use the time series data from January1996 to December 2015 and apply Co-integration, Granger Causality test and Vector Auto Regression to assess the impact of Crude Oil Prices on Inflation. In India the relationship Between the Crude Oil prices and Inflation have Insignificant short term relationship and the variables are not co-

integrated but the past values of Inflation affect the present values of Oil prices and Vice Versa so there is a bidirectional causality between the variables. In USA Inflation and Oil Prices are not co-integrated and they have Insignificant Short term Relationship between the Variables and there is no causality i.e. past values of Oil prices does not affect the Present values of Inflation and vice versa. In China Inflation and Oil prices are not co-integrated and they have significant positive short term relationship and there is no causality between the variables. So in India if prices of Crude oil increases the Inflation is also rises. So, government has to take necessary steps to reduce the volatility in Crude Oil prices and make use of natural gases and conserve the money which is spent on Crude oil prices which will reduces the exchange rate and helps India, China and USA to increase the Export of petroleum products.

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