

THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES

Co-integration and Granger Causality Test of Crude Oil Price, Exchange Rate, KIBOR and Consumer Price Index of Pakistan

AtherAzim Khan

Professor, University of Central Punjab-UCP, Lahore, Pakistan

Muhammad Asif

Student, Department of Commerce, UCP, Lahore, Pakistan

Muhammad RamzanMehar

Student, Department of Commerce, UCP, Lahore, Pakistan

Abstract:

This study is an attempt to find out the Granger Causality and Co-integration among Crude Oil Prices, Exchange Rate of PKR/USD, KIBOR and Consumer Price Index of Pakistan. The researchers collected monthly data from secondary sources for a period of 108 months from January 2005 to December 2013. Granger Causality and Co-integration techniques are applied to analyze the data. Assumptions of these models are checked using appropriate statistical tests before application. Both co-integration tests, that is, Trace Test and Maximum Eigen Value Test show that three variables are co-integrated with each other. Granger Causality results show that causality is found between CPI and Crude Oil Prices of Pakistan and also between CPI Exchange Rate.

Keyword: Crude oil, exchange rate, KIBOR, CPI, granger causality and co-integration

1. Introduction

This study is about application of Johansen's Co-integration and Granger Causality Test among Crude Oil Price, Exchange Rate, Karachi Inter-Bank Offered Rate (KIBOR) and Consumer Price Index-CPI. After a big shock in oil prices over the period of 1973-1980, there were dozens of academic and practical researchers who tried to find out the relationship between oil price and macroeconomic variables (Masih & Mello, 2011). On the other hand oil and gas sector is considered an important factor for all the developed and developing countries (Kiani, 2010). Due to increase in oil and gas prices in international market many countries bear economic cost in different ways, like direct effect on the domestic oil prices resulting into loss of production and hence decrease in GDP. Energy prices go up with escalation in oil prices affecting both inflation and exchange rate.

Considering the importance of oil prices for the development of economy the research question of this paper is developed, which is to find out the relationship of Crude Oil Price, Exchange Rate, KIBOR and CPI. The objectives of this study are: to find out the integration of Crude Oil Price, KIBOR, Consumer Price Index and Exchange Rate; to assist investors and organizational policy makers in making macro economic decisions where crude oil price is significantly related; to provide researchers with literature and empirical evidence for analysis and future research. The focus of this research paper is on Pakistan and all variables are taken with the same reference. It is hypothesized in this study that Crude Oil Price does have significant relationship with Exchange Rate, CPI and KIBOR of Pakistan. Co-integration technique and Granger Causality test are applied for analysis. Augmented Dickey-Fuller Unit Root Test is used to check stationarity of data before applying Johansen's Co-integration model to develop relationship between the variables.

2. Literature Review

Similar studies were conducted by various researchers with variables such as Stock Price and Exchange Rate. Hussain and Zakir (2009), Abdulaziz, Chortareas and Cipollini (2008), Muhammad and Husain (2003), Rasheed and Abdual (2002), and Ibrahim (2000) studied the variables in Middle East, Thailand, South Asia, Malaysia and France. Various researchers conducted similar relational studies on Oil Price and Exchange Rate. Adiguzel, Bayat, and Nezoglu (2013), Masih and Mello (2011), Roselee and Samad (2009) and Akram(2004) conducted research on Brazil, India, Turkey, South Korea and Norway; these studies investigated the relationship between Stock Price, Exchange Rate and the impact of Oil Price on Stock Exchange and CPI. Asghar and Nadia (2013), Javed and Tariq (2009), Alagidede and Zhang (2010), Kiani (2010), Harri and Hudson (2009), Rahman and Hashim-Uddin (2009), Rashid (2008) and Farooq and Kazmi (2005) conducted similar studies on Negeria and SAARC countries.

Some variables of this study were used in similar studies, like Stock Price and Exchange Rate, by other researchers such as Ibrahim (2000), Muhammad and Husain (2003) and Azman-Saini and Azali (2003). Oil Price, Consumer Price Index and Exchange Rate were used in their study by Asghar and Nadia (2013). Hussain and Zakir (2009) took stock price as explained variable and macroeconomic variables, Exchange Rate, Industrial Production, Market Rate of Interest and Consumer Price Index

as explanatory variables. Zhu (1998) included Foreign Exchange Rate as a dependent variable and Crude Oil, Corn, Soybeans, Soyabns Oil, Cotton, Wealth Prices, Interest Rate, Stock Price and Consumer Price Index as an independent variables. Variables used by Masih and Mello (2011) were Interest Rate, Economic Activity, Real Stock Return, Oil Price Volatility and Industrial Production.

A number of researchers including Rukh, Ahmad, Bilal, and Khan (2011) and Haroon and Jabeen (2013) collected monthly data of macroeconomic variables i.e. Treasury Bill Rate, Wholesales Prices Index and Consumer Price Index for a period of ten years from 2001 to 2010 of apply Correlation and Regression Models. Hasan and Javed (2009) took data for a period of ten years from 1998 to 2008 and applied Multivariate Cointegration and Granger Causality Analysis. Akmal (2007) investigated the association between Stock Return and Inflation for a period of 36 years from 1971 to 2006, he applied Auto Regressive Destributed Lag (ARDL) Model, Error Correction Model (ECM) and Co-integration Technique. Rasheed and Abdual (2002) took monthly data from January 1994 to December 2000 and applied Johansen's and Juselius's Co-integration, Augmented Dickey Fuller and Granger Causality.

Kiani (2010) found that Crude Oil Price has negative relationship with Real Output and Real Government Expenditures and also found that sharp increase in Crude Oil Price has negative effect on GDP growth of Pakistan's economy. Another study found that there is a significant long-run and short-run relationship between Oil Prices and Oil Stock Prices; the study included the effect of interest rate on stock index (Roselee, Fazilah, & Sonal, 2009). Abdulaziz, Chortareas, and Cipollini (2008) conducted a study on similar variables and found that Stock Prices, Exchange Rates and Oil Price are co-integrated in Egypt, Oman, and Saudi Arabia and Stock Prices and Oil Prices also co-integrated with each other in Kuwait. Masih and Mello (2011) concluded in their study that long run equilibrium relationship exists between Interest Rate, Oil Prices, Industrial Production, Oil Price Volatility, and Real Stock Returns; the other conclusion of the research was that Oil Prices movement has a significant effect on the stock market.

According to the findings of relevant literature the relationship between Crude Oil Prices and Exchange Rate is positive. Similarly positive relationship is found between Crude Oil Price, KIBOR, and CPI. Theory elobrates the effect of Exchange Rate and Intrest Rate on world demand for Oil and Gas through aggregate demand and supply as the impact of structural demand and supply of Oil and Natural Gas; so monetry policy has signifacant effect on Oil and Gas market; therefore, it becomes very interesting to analyze the relationship between Interest Rate and Exchange Rate and Oil and Gas prices (Kreichene, 2007). The logical link of the vairables leads to this study.

3. Data and Methodology

The data is collected in this research from the website of KSE, Index Mundi and State Bank of Pakistan, which are all secondary sources. Monthly time series data is used in this study from January 2005 to December 2013. Variables taken for this Study are Crude Oil Price (as in the international market; price is taken in terms of USD per barrel), Exchange Rate (is the Rupees and US Dollars exchange rate), KIBOR (Karachi Inter-Bank Offered Rate), and Consumer Price Index-CPI (which shows the general level of inflation in Pakistan). Data is run to apply the relevant tests and models. To apply Granger Causality and Co-integration techniques all assumption are checked. Augmented Dickey Filler Test is applied to check stationary of data and Data is found Stationarity at 1st difference level.

4.1. Result and Interpretation

The objective of Co-integration Model is to check the relationship among Crude Oil Prices and Exchange Rate, KIBOR and Consumer Price Index of Pakistan. Johansen's Co-integration test is used to check the relationship between variables. Granger Causality Test used to find out usefulness of one time series to forecast another time series. This is to find the ability of one time series variable to predict another time series variable i.e. predictive causality. The results of ADF are shown in the following table:

Variables	t-statistics	Significance level	Probability
D(Crude Oil)	-6.149224	1% =-4.046925 5% =-3.452764 10%=-3.151911	0.0000
D(Exchange Rate)	-5.911814	1% =-3.976260 5% = -3.418709 10%=-3.131880	0.0000
D(KIBOR)	-12.41421	1% =-4.047795 5% =-3.453179 10%=-3.152153	0.0000
D(CPI)	-9.906725	1% =-3.493129 5% =-2.888932 10%=-2.581453	0.0000

Table 1: Augmented Dickey Fuller Test

Table 1 shows the results of ADF test. Results of all variables are significant at first level showing that the variables are stationary at 1st difference. The null-hypothesis can be rejected for all the variables. All variables are stationary, because the value of 1%, 5% and 10 % are below the t-statistic and respective values of probability of all included variables are also less than 0.05 indicating that all variable are stationary. Results of co-integration are shown below in Table 2.

Hypothesized		Trace	0.05	
No. of CE(s)	Eigen-value	Statistic	Critical Value	Prob.**
None *	0.356830	117.2275	47.85613	0.0000
At most 1 *	0.291308	72.21014	29.79707	0.0000
At most 2 *	0.213132	37.08803	15.49471	0.0000
At most 3 *	0.116544	12.63919	3.841466	0.0004
Trace test indicates 4 co-integrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 2: Unrestricted Co-integration Rank Test (Trace)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigen-value	Statistic	Critical Value	Prob.**
None *	0.356830	45.01737	27.58434	0.0001
At most 1 *	0.291308	35.12211	21.13162	0.0003
At most 2 *	0.213132	24.44884	14.26460	0.0009
At most 3 *	0.116544	12.63919	3.841466	0.0004
Max-Eigenvalue test indicates 4 co-integrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**Mac KinnonHaug-Michelis (1999) p-values				

Table 3: Unrestricted Co-integration Rank Test (Maximum Eigen-value)

Table 2 and 3 show results of testing Co-integration. Co-integration technique is applied because all the variable are stationarity at same level. There were 108 observations for the test but after adjustment 106 observations were included. Data contained in the analysis have linear deterministic trend. Both the tables are Trace Statistics and Eigen Value Statistic respectively. Results show that all the variables are co-integrated with each other at 5% significance value. In both tables the null hypotheses of co-integration are rejected against alternate hypotheses.

Null Hypothesis	F-Statistic	Probability
D(EXCH) does not Granger Cause D(CRUDE)	1.92642	0.1681
D(CRUDE) does not Granger Cause D(EXCH)	0.57700	0.4492
D(CPI) does not Granger Cause D(CRUDE)	4.36360	0.0392
D(CRUDE) does not Granger Cause D(CPI)	2.18176	0.1427
D(KIBOR) does not Granger Cause D(CRUDE)	0.64178	0.4249
D(CRUDE) does not Granger Cause D(KIBOR)	0.06840	0.7942
D(CPI) does not Granger Cause D(EXCH)	11.3249	0.0011
D(EXCH) does not Granger Cause D(CPI)	0.48531	0.4876
D(KIBOR) does not Granger Cause D(EXCH)	0.02342	0.8787
D(EXCH) does not Granger Cause D(KIBOR)	0.91303	0.3415
D(KIBOR) does not Granger Cause D(CPI)	0.00160	0.9681
D(CPI) does not Granger Cause D(KIBOR)	0.46671	0.4960

Table 4: Granger Causality

The result of Table 4 based upon 106 data points and test performed at lag 1 value. The p value of 0.0392 for CPI, suggests that CPI does Granger Cause Crude Oil. We reject null hypothesis that CPI does not Granger Cause Crude Oil. So, CPI Significantly granger Cause Crude Oil prices of Pakistan. The probability value is 0.0011 means CPI does Granger cause Exchange Rate, we also reject the null hypothesis. But the probability value of remaining variable is greater than 0.05. Due to this we cannot reject the null hypotheses and state that all other variables do not Granger Cause the other variables.

4. Conclusions

On the basis of co-integration results we can conclude that three variables are co-integrated. These results are consistent with the results of Roselee, Fazilah, and Sonal (2009). Further, Crude Oil Price and Inflation have causality and can be used to predict each other. Similarly, Inflation and Exchange Rate are two variables which have significant causality and can be used to predict each other in Pakistan. Other variables do not have the power to predict each other.

5. References

1. Abdulaziz, M., Chortareas, G., & Cipollini, A. (2008). Stock prices, exchange rates, and oil: Evidence from Middle East oil exporting countries. *School of Accounting Finance and Management*, 1-27.
2. Adiguzel, U., Bayat, T., & Nezoglu, S. K. (2013). Oil prices and exchange rates in Brazil, India and Turkey: Time and frequency domain causality analysis. *Siyaset, Ekonomi ve Yonetim Arasturmalan Dergisi*, 1, 49-73.
3. Akmal, M. S. (2007). Stock return and inflation: An ARDL econometrics investigation utilizing Pakistan data. *Pakistan Economic and Social Review*, 89-105.
4. Akram, Q. (2004). Oil prices and exchange rates: Norwegian evidence. *Econometrics Journal*, 7, 476-504.
5. Alagidede, P., Zhang, T., & Xu, P. (2010). Causal relationship between stock prices and exchange rates. *Stirling Economics Discussion Paper*, 1-21.
6. Asghar, I. A., & Nadia. (2013, February). The impact of oil price on stock exchange and CPI in Pakistan. *Journal of Business and Management*, 7(6), 32-36.
7. Azman-Saini, W. N., & Azali, M. S. (2003). Stock prices and exchange rate: Evidence from Thailand. *Giordano Dell-Amore Foundation*, 27(3), 245-258.
8. Bokhari, I. H. (2013). Social relationship between exchange rate and stock prices: A case on SAARC economies. *Academy of Contemporary Research Journal*, 175-181.
9. Farooq, M. T., Kazmi, W. W., & Ali, A. (2005). Linkage between stock market prices and exchange rate: A causality analysis for Pakistan. *Pakistan Institute of Development Economics*, 43(4), pp. 639-649. Islamabad.
10. Haroon, M. A., & Jabeen, H. (2013). Impact of macro-economic variables on share price behavior of Karachi Stock Exchange. *Pakistan Journal of Commerce and Social Sciences*, 7(3), 493-504.
11. Harri, A., & Hudson, L. N. (2009). The relationship between oil, exchange rates and commodity prices. *Journal of Agricultural and Applied Economics*, 41(2), 501-510.
12. Hasan, A., & Javed, M. T. (2009). An empirical investigation of the causal relationship among monetary variables and equity market returns. *The Lahore Journal of Economics*, 115-137.
13. Hussain, N., & Zakir, S. (2009). Long run and short run relationship between macroeconomic variables and stock prices in Pakistan: A case of Lahore Stock Exchange. *Pakistan Economic and Social Review*, 47(2), 187-198.
14. Ibrahim, M. H. (2000). Cointegration and granger causality tests of stock price and exchange rate interaction in Malaysia. *ASEAN Economic Bulletin*, 17(1), 36-47.
15. Javed, F., & Tariq, G. (2009, August). Relationship between trading volume and stock exchange performance: A case of Karachi Stock Exchange. *International Business and Economics Research Journal*, 8(9), 13-20.
16. Kiani, A. (2010). Impact of oil prices on Pakistan's economic growth. *International Journal of Business and Social Science*, 2(17), 209-216.
17. Kreichene, N. (2007). An oil and gas model (Vols. 7-135). *International Monetary Fund. African Dept.*
18. Masih, R., & Mello, S. P. (2011). Oil price volatility and stock price fluctuations in an emerging market: Evidence from South Korea. *Energy Economics*, 33(5), 975-986.
19. Muhammad, N., & Husain, A. R. (2003). Stock prices and exchange rates: Are they related? Evidence from South Asian countries. *Pakistan Institute of Development Economics*, Islamabad, 41(4), pp. 535-550.
20. Rahman, L., & Hashim-Uddin. (2009). Dynamic Relationship between stock prices and exchange rates: Evidence from three South Asian Countries. *International Business Research*, 2(2), 167-174.
21. Rashid, A. (2008). Macroeconomic variables and stock market performance: Testing for dynamic linkages with a known structural break. *Research Center on International Cooperation of the University of Bergamo*, 32(1), 77-102.
22. Roselee, S., & Samad, F. B. (2009). Performance and volatility of oil and gas stocks: A comparative study on selected oil and gas companies. *International Business research*, 2, 87-99.
23. Roselee, S., Fazilah, S., & Sonal, B. (2009). Performance and volatility of oil and gas stocks: A comparative study on selected O & G companies. *International business research*, 2, 87-99.
24. Rukh, L., Ahmad, K., Bilal, H., Khan, S., & Zohaib, K. (2011). Effect of discount rate, T-Bills and CPI on trading volume of KSE 100 Index. *Asian Journal of Business and Management Sciences*, 1, 25-34.
25. Zhu, Z. (1998). Stock prices and exchange rate in a structural model with an application to the case of France. *Journal of Economic Integration*, 13(1), 89-107.