IMPACT OF OIL PRICES ON STOCK MARKETS: EMPIRICAL EVIDENCE FROM SELECTED MAJOR OIL PRODUCING AND CONSUMING COUNTRIES

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ABSTRACT

This paper analyzes the impact of oil prices on stock prices of selected major oil producing and consuming countries with nominal exchange rate as additional determinant. Daily stock prices, oil prices, and exchange rates for six countries (Mexico, Russia, Saudi Arabia, India, China, and the US.) from January 26, 2000 to January 22, 2010, are modeled as a cointegrated system in Vector Autoregressive analysis. Variance decompositions and impulse responses are also estimated. Our empirical results support unit root in all variables (except Saudi Arabia and the US exchange rates that are stationary in levels and first difference). Evidence of one long-run relationship (Mexico inconclusive) in Saudi Arabia, India, China and the US is supported, while Russia exhibits two long-run relationships. The results from the long-run exclusion test suggest all three variables cannot be eliminated from cointegrating space in all countries (except Mexico), while the weak exogeneity test reveals all variables to be responsive to deviation from long-run relationships (except China). Unlike the exchange rates, stock and oil prices are nonresponsive to deviations in the long-run in China. In all countries, variance decomposition and impulse response tests confirm existence of oil prices and exchange rates influences over stock prices.

Key Words: Cointegration, exchange rates, oil prices, stock prices, VAR, VECM pairwise Granger causality, variance decompositions, impulse responses, weak exogeneity.

JEL Codes: G14, G15

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I. INTRODUCTION AND LITERATURE REVIEW

Recent trend in the energy sector (crude oil market) have reignited research interest in the oil price–macroeconomics relationships and oil prices-stock prices long-run relationships. Several studies have explored the oil price-macroeconomics casual link and among them are Hamilton (1983), Burbridge and Harrison (1984), Gisser and Goodwin (1986), Mork (1989), Loungani (1986), Hooker (1996), Hamilton (2000), and Francois and Valerie (2008).

Research by Jones and Kaul (1996), Huang et al (1996), Sadorsky (1999), Papapetrou (2001), Ciner (2001), Yang and Bessler (2004), El Sharif et al (2005), Anoru and Mustafa (2007), McSweeney and Worthington (2007), and Miller and Ratti (2009) have investigated the effects of oil prices on stock prices in developed countries. In addition, studies by Maghyereh (2004), Onour (2007), Aliyu (2009), Nandha and Hammoudeh (2006), and Narayan and Narayan (2010) explored the relationship between oil prices and stock prices in emerging and developing countries.

Hamilton (1983) provided evidence of correlation between oil price and economic output, and further claimed that oil price was to be blamed for every post-World War II (1948-1972) recessions in the US economy. According to the author, the data (real GNP, unemployment, implicit price deflator for nonfarm, hourly compensation per worker, import prices, and M1) indicated that economic recession preceded an oil price increase after 3-4 quarters, with recovery starting after 6-7 quarters. Gisser and Goodwin (1986), Mork (1989), and Hooker (1996) provided evidence in support of Hamilton's findings.

Jones and Kaul (1996) studied the response of international stock markets to changes in the oil prices using quarterly data. The study focused on stock returns from the US, Canada, the UK, and Japan, utilized simple regression models, and reported that the stock returns for all countries (except the UK) were negatively impacted by oil prices.

Sadorsky (1999) used monthly data to probe the relationship between oil prices and stock returns for the US from January 1947 to April 1996. The author applied variance decomposition. The findings suggested that oil prices and stock returns have a negative relationship in the short term, meaning higher oil prices lead to lower stock returns.

Papapetrou (2001) applied vector error correction modeling to study the effect of oil prices on stock returns for Greece using daily data and the variance decomposition. The study suggested a negative oil prices effect on stock returns that extended over four months.

Maghyereh (2004) studied the dynamic linkage between oil price and stock returns in 22 emerging economies using the unrestricted Vector Autoregressive (VAR) approach proposed by Sim (1980) with daily data. The research investigated the effectiveness of innovations transmission from oil market to emerging equity markets, utilizing forecast error variance decomposition and impulse response analysis. According to the author, a plot of each emerging equity market response to a shock in the oil price suggested a gradual transmission with the equity market reacting to the shock two days after. While the speed of adjust slowly declined to zero on the fourth day in 16 countries, the response continued to the seventh day in Argentina, Brazil, China, Czech Republic, Egypt, and Greece. The impulse response demonstrated gradual diffusion of innovations from the oil market into the emerging equity markets. Furthermore, the author postulated the slow adjustment to imply the presence of inefficiency in the emerging equity markets transmission of innovations from oil market. The variance decomposition revealed very weak evidence of cointegration between oil price shocks and stock market returns. In addition, the author stated that the oil market is an ineffective influence on the equity market because the sizes of responses are very small.

Anoruo and Mustafa (2007) examined the relationship between oil and stock returns for the US using daily data, Johansen Bivariate Cointegration, and error-correction approach. The findings indicated long-run relationship between oil and stock returns in the US. The estimated Vector-error-correction Model (VECM) provided evidence of causality from stock market returns to oil market and not vice versa. Although the Johansen and Juselius estimation technique did not yield evidence of cointegration, the Gregory-Hansen cointegration tests[2] provided evidence of both oil and stock markets being cointegrated. The authors stated that this result implied that both markets are integrated and not segmented. Consequently, the authors believed that diversifying in both markets will not create benefits for the investors holding the portfolio because of the integration of the markets, and that risk minimization through portfolio diversification are unattainable by holding assets in oil and stock markets.

Narayan and Narayan (2010) assessed the relationship between oil prices and Vietnam's stock prices with daily series from 2000 to 2008. Using the Johansen test, the findings provided evidence of oil prices, stock prices, and exchange rates for Vietnam sharing a long-run relationship. In addition, the study found both oil prices and exchange rates have a positive and statistically significant effect on Vietnam's stock prices in the long-run and not in the short-run.

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[2] According to the authors, the Gregory-Hansen cointegration tests enabled examination of structural break in the data while testing for evidence of long-run relationship.

The focus of this paper is to contribute to the literature by investigating oil prices relationship with stock prices and exchange rates in the long-run. First, this study identifies three major oil producing countries and three major oil consuming countries from a list of the "Top World Producers" in 2008 compiled by the US Energy Information Administration[3]. These six countries are selected based on availability of data. The three selected major crude oil producing countries are Saudi Arabia, Russia, and Mexico, ranked number 1, 2 and 7 in 2008 with 10782, 9790 and 3186 barrels per day production, respectively. Likewise, the selected major oil consuming countries are the US, China, and India ranked number 1, 2 and 4 with 19498, 7831, and 2962 barrels per day consumption, respectively.

Second, this study tests each variable for evidence of unit root, then probes the dynamic link between financial markets, exchange rates and changes in oil prices with the Johansen multivariate cointegration test[4]. VECM Pairwise Granger Causality test, exclusion and weak exogeneity test, forecast error variance decomposition, and impulse response are also utilized in this study. While the VAR analysis examines the cointegration relationship, the VECM Pairwise Granger Causality probes for evidence of lead-lag interactions among oil prices, equity prices, and exchange rates in the six countries. Evidence of cointegration implies that the series do not move apart in opposite direction for extended periods without drifting back to a mean distance. Also, evidence of lead-lag interaction suggests oil prices to be leading the equity and exchange rates markets, or one of the sectors, and vice versa. Variance decomposition demonstrates the proportion of variation in the oil prices that will be due to oil price shock and shocks from equity and exchange rates markets and vice versa. Likewise, impulse response illustrates the impact of a unit shock to the error of each equation. These tests enable this research to identify evidence in support of its focus.

Third, we examine China, India, and the US because they are ranked number 1, 2 and 4 as major oil consumers on the globe by the US Energy Information Administration. From 2002 to 2010, oil prices have quadrupled partly because of the surge in demand from China, India and to some extent the US[5], while China and India are the new comers to the club of global guzzlers.

Besides introduction and literature review in section 1, the rest of this research is organized as follows. While section 2 presents the data and empirical frame work, and section 3 focuses on the empirical results and conclusion.

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[3] See http://tonto.eia.doe.gov/country/index.cfm

[4] Unrestricted Vector Autoregressive (VAR) analysis

[5] Increased demand for oil from China and India is not the sole factor responsible for higher oil prices. Some other factors include crisis in Niger-Delta in Nigeria, the first and second Gulf War, speculations in the oil commodity market, etc.

II. DATA AND EMPIRICAL FRAMEWORK

A. Cointegration, Weak Exogeneity, Long-run exclusion, Causality and Innovation Accounting

Many macroeconomics and financial variables influence stock market prices movement over time, and oil prices and exchange rates are no exception. Researchers have utilized different empirical models and methodology in the examination of the effects of oil prices and/or exchange rates on the stock market[6] in developed and some emerging economies, while research work on developing and newly adopted free market economies (i.e., Russia) is scanty.

This study focuses on probing recent equity, oil, and exchange rates data between January 2000 and January 2010 for evidence of long-run equilibrium relationship, responses, causality, interdependence among the variables, and impact of oil price shock on the stock market returns using innovation accounting. We estimated the Narayan and Narayan (2010) model as follows:

$$lnSP_t = \alpha_0 + \beta_1 lnOILP_t + \beta_2 lnER_t + \varepsilon_t \qquad (1)$$

In Equation (1), $lnSP_t$ and $lnOILP_t$ are the natural log of stock prices and oil prices at time t, respectively, while $lnER_t$ is the natural log of exchange rate (local currency/US dollar). Equation (1) is estimated for each of the six countries in this study.

Engle and Granger (1987) state that a linear combination of two or more non-stationary variables may be stationary even if each variable is non-stationary; consequently, the series are cointegrated because there is a linear combination of the series that is stationary, while the stationary linear combination is the cointegrating equation and is deemed to be a cointegrating vector. In general, if data with different orders of integration are linearly combined, the combination will produce an order of integration equal to the largest value of the orders (Brooks, 2008).

Among the different types of cointegration tests that are available, we estimate equation (1) with VAR-based cointegration tests using the Johansen (1991, 1995) methodology and carry out other tests that include VECM Pairwise Ganger Causality test[7], long-run exclusion test, weak exogeneity test, VAR, forecast error variance decomposition, and impulse response.

Narayan and Narayan (2010) postulated the theoretical underpinning between stock prices and oil prices to be equity prices as discounted returns of expected future cash flows. Systematic movements in expected cash flow and discount rate do have

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[6] See Park and Ratti (2008), Cong et al (2008), Narayan and Narayan (2010), and Anoruo and Mustafa (2007).

[7] VAR stability test was also conducted to test the stability of the VAR model before carrying variance decomposition and impulse response.

some bearing on stock prices, and an increase in oil prices leads to higher cost of production, reduces profits in the immediate thereby lowering stock prices, downsizing, and possibly chapter 11 bankruptcies[8]. Additional explanation provided by Haung et al (1996), and Narayan and Narayan (2010) go as follow: the discount rate reflects both expected inflation and expected real interest and are affected by oil prices. As a result, a hike in the prices of oil will be detrimental to major oil consuming country's foreign exchange rate and aggravate expected domestic inflation rate, while major oil producing countries will benefit. Thus, any increase in expected domestic inflation rate for a major oil consuming country will lead to a higher discount rate and will have an adverse effect on stock prices. In addition, Haug et al (1996) and Narayan and Narayan (2010) argued that stock returns are impacted by expected oil prices through discount rate, while discount rate consists of expected inflation rate and interest rate. The authors cited the US as an example of a net oil importer (major consumer) whose balance of payment and foreign exchange rates are negatively impacted with upward pressure on domestic inflation when oil prices increases.

Changes in the exchange rates may have a positive or negative impact on the equity returns depending on whether the country is a major oil importer or exporter. Dornbusch and Fisher (1980) and Narayan and Narayan (2010) stated that an appreciation of the exchange rate of a major producing country reduces competitiveness of exports with adverse effect on domestic stock prices. Likewise an appreciation of the exchange rate of a major consuming country reduces input costs thereby increasing domestic stock prices and vice versa.

B. Data Description

The sample period for the oil prices, stock prices, and exchange rate is daily from January 26, 2000 to January 22, 2010. Because of different observed holidays in the six countries, the total observations ranges from 2,490 to 2,505. Stock prices and exchange rates for Saudi Arabia, Mexico, Russia, China, and India are obtained from Trading Economics[9]. The exchange rate is local currency/US dollar. While the oil prices are West Texas Intermediate (WTI) spot acquired from the US Energy information Administration's web site, the exchange rate for the US is the US dollar/World Exchange rate of major currencies obtained from St. Louis Federal Reserve Bank's web site. The stock prices are SP 500 and all data series are transformed into log to stabilize the variability in the data. We use the EView software for all analysis.

[8] Similar explanation is provided by Narayan and Narayan (2010).
[9] www.tradingeconomics.com

III. EMPIRICAL RESULTS AND CONCLUSION

A. Unit Root

To test for unit root in level, first and second difference, we utilized the Augmented Dickey-Fuller and Dickey-Fuller generalized least squares tests with constant and trend, and without trend. Both Augmented Dickey-Fuller and Dickey-Fuller generalized least squares tests have the same null hypothesis of unit root in each variable. The lag length for each variable is chosen using the Schwarz Bayesian criteria. The results of both tests without trend are in Table 1, while the results with constant and trend are not reported[10]. With the exception of Saudi and the US exchange rates, the ADF and ADF-GLS test critical values are more negative than the test statistics of all other variables in level, thus the null hypothesis of a unit root cannot be rejected[11].

B. Evidence of Long-run Relationships, Analysis and Causality,

To test for evidence of long-run equilibrium relationship among stock market prices, oil prices, and exchange rates, Equation (1) is estimated with a VAR-based cointegration test using the Johansen (1991, 1995) and the optimal lag length is selected after testing for the lag structure and viewing the roots and modulus. We carried out impulse response and variance decomposition analysis[12] and the results will be discussed later. Furthermore, the estimated VAR is stationary if the roots have modulus that is less than one and located inside the unit circle. For all countries, the optimal lag length ranges from 1 to 7 and are selected using Schwarz Information criterion[13].

Table 2 displays the results of the cointegration test. The findings suggest stock prices, oil prices, and exchange rates share one long-run relationship in China, India, Saudi Arabia and the USA, and two long-run equilibrium relationships in Russia. This implies that these variables do move simultaneously and are bind together by a single force in China, India, Saudi Arabia, and the US (except Mexico) and two forces in Russia over time. Although these markets may wander apart for some time, they will revert back to their mean distance in these countries. In the case of Mexico, while Trace

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[10] The author has the results with constant and trend both using Augmented Dickey-Fuller and Dickey-Fuller generalized least squares tests.

[11] Implying that the series are non-stationary in levels and integrated of order one. The null hypothesis of unit roots in the first difference is rejected because the test statistics of each variable is more negative than the ADF and ADF-GLS test critical values.

[12] As EView user guide II (2009) explains, because we will be testing for impulse response the estimated VAR must be stationary otherwise the impulse response standard error will not be valid.

[13] The result of the AR roots for VAR stability suggests that the VAR estimated for each county is stable because the roots are less than one and lie inside the unit circle. Results are not reported in the paper because of limited space.

test indicates evidence of long-run relationship when estimated with trend, the maximum eigenvalue test suggest otherwise[14], hence the finding of cointegration is inconclusive.

Next, Table 3 presents the results of normalized cointegrating vector coefficient (β), its standard error (in Column 3), the adjustment coefficients and it standard error in column 4. This table also displays the results of the long-run exclusion and the weak exogeneity tests including the Chi-square and probability values. Because evidence of long-run relationship in Mexico is inconclusive, Mexico is excluded from both tests. Since Russia has two cointegrating relationships, null hypothesis is that the oil prices do not appear in the first and second cointegration equations and as a result will not share long-run relationship with the other two variables. Similarly, the hypothesis for stock prices and exchange rates is tested for all countries with evidence of cointegrating relationship. The long-run exclusion test is performed by estimating the VAR with β parameters set equal to zero in both cointegration equations in the case of Russia and one equation in all other countries (except Mexico). Looking at the long-run exclusion test results, none of the three variables can be eliminated from the long-run vector; rather, all three variables are significant and must be included in the cointegration equation for all countries (except Mexico). Moreover, we investigate any deviation of stock prices, oil prices, and exchange rates from the already established cointegrating relationship because of external shock. Hendry and Juselius (2000) state that in a system with several long-run relationships, the hypothesis that a variable is long-run weakly exogenous is to set a row of α-coefficients to be zero. Upon testing, there is evidence of China's stock prices and oil prices being weakly exogenous, implying that these variables are non-responsive to past period deviations from long-run relationships. In all other countries, the three variables are responsive to deviation from cointegrating relationships.

In addition, the nature of causality among all three variables in pairs for Mexico, Saudi Arabia, Russia, China, India, and the US are probes and the findings are in Table 4. Aliyu et al (2010) argues that the block exogeneity rules out the effect of all other endogenous variables in the VECM other than the lag of exogenous variable, while the VECM pairwise Granger causality test examines the extent of causality (i.e., lead-lag). There is evidence of strong causality and dependence of stock prices to oil prices, and stock prices to exchange rate in Mexico, Russia, Saudi Arabia, and the US. Additional support for strong causality and dependence of oil prices to exchange rate exist in Russia, Saudi Arabia, China, India and the US, while the support in Mexico is very weak. Unlike the other countries, there is no evidence of strong causality and dependence of oil prices, and exchange rate to stock prices in China and India. Rather, exchange rates lead the other two markets in China, while the oil market leads in India. Block exogeneity is significant in all countries indicating the important position of historical information in the establishment of the degree of causality in the level of stock

[14] We also estimated without a trend and both maximum eigenvalue and trace test reject cointegration at 5% level.

prices, oil prices, and exchange rate, excluding the impact of other factors originating internally.

C. Innovation Accounting-impulse Response and Variance Decomposition

Next, we present the findings from impulse response and variance decomposition analysis. Impulse response function traces the effect of a shock to and from the independent variable to other factors in the VAR[15]. Thus, impulse response illustrates the impact of a unit shock to the error of each equation of the VAR. In Table 5 the findings suggest that stock prices are responsive to innovations in oil prices in Russia, Saudi Arabia, China, India, and the US meaning that in these countries, stock prices are influenced by oil prices. For instance, responses of stock prices 60 days after shock in oil prices are 0.1%, 6%, 2%, 2%, 2% and 9% in Mexico, Russia, Saudi Arabia, China, India and the USA, respectively. We believe that one of the reasons why the response is greater in the US stock prices is because oil is priced in the US dollar. Stock prices are also responsive to innovation in oil prices and after 60 days, the responses are 0.04%, 10%, 22%, 12%, 2% and 5% in Mexico, Russia, Saudi Arabia, China, India and the US, respectively. Evidence supports the hypothesis of this paper, that is, oil prices and exchange rates influence stock prices in both major oil exporters and importers' countries. Especially, in the major oil exporting countries, the shocks from oil prices and exchange rates do have longer lasting effect. That is, the impact of oil prices and exchange rate take a very long time (more than 120 days) to work through the system. Maghyereh (2004) also found innovations in the oil market to gradually diffuse in emerging stock markets, thus supporting the findings in this paper. The implication is that the longer it takes for innovation to pass through the system, the greater the probability and opportunity for arbitrage between the stock and crude oil commodity markets and the benefit of portfolio diversification.

Brooks (2008) states that variance decomposition accounts for the share of variations in the endogenous variables resulting from the endogenous variables and the transmission to all other variables in the system, because of the dynamic nature of the VAR. Variance decomposition also known as innovation accounting techniques offers a workable option for describing the dynamic relationship between variables that share long-run relationships (Refalo, 2009). Since there is evidence of cointegration among the three variables in all countries (but inconclusive in Mexico), variance decomposition will therefore provide a viable technique for explaining the dynamic relationships among stock, oil, and exchange rate markets. The findings in Table 6 shows that oil prices have a strong influence on stock prices in Mexico, Russia, and Saudi Arabia, and a minimum effect in China and India. For instance, after 60 days oil prices are responsible for over 4%, 11%, 2%, and 8% of the variation in stock prices in Mexico, Russia, Saudi Arabia, and the US, while exchange rates account for 19%, 3%, 3%, 3%,

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[15]. A shock to the i-th factor has direct effect on the i-th factor and also affects all other factors in the system by way of the dynamic structure of the VAR.

and 2% of movement in the stock prices in Mexico, Russia, China, India, and the USA, respectively.

IV CONCLUSION

Empirical findings presented in this paper support existence of unit root in the variables (except exchange rates for Saudi and the US). There is also evidence of two cointegrating relationships in Russia and one cointegrating relationship in Saudi, China, India, and the US, while the result of Mexico is inconclusive. Existence of one or more cointegrating vector in a VAR implies the presence of one or more forces binding the data in the long-run (Hammoudeh and Aleisa, 2004). Findings from the long-run exclusion test reveal that none of the variables can be excluded from the cointegrating relationship in five countries. Stock prices and oil prices exhibit weak exogeneity in China, while there is no evidence of weak exogeneity in other countries.

Table 1: Unit Root Tests: Selected Major Oil Producers and Consumers

	Mexico	**Russia**	**Saudi Arabia**	**China**	**India**	**USA**
	L & D	L & D	L & D	L & D	L & D	L & D
	ADF					
LSP	-0.312	- 1.063	- 1.476	- 0.834	-0.182	-1.800
	-35.729*	-48.361*	-26.918*	-48.732*	-46.098*	-0.334*
LOILP	-1.524	- 1.431	- 1.399	- 1.440	-1.435	-1.441
	-50.950*	-51.701*	-51.413*	-50.072*	-51.430*	-51.331*
LEX	-1.233	- 1.286	-9.760***	2.948	-1.545	-51.331***
	-51.488*	-42.608*	-18.358*	-50.653*	-47.198*	-50.889*
	ADF-GLS					
LSP	1.101	0.6464	0.143	- 0.214	0.284	-0.976
	-5.256**	-3.700**	-3.159**	- 3.306**	-46.100**	-7.303**
LOILP	-0.309	-0.309	-0.596	- 0.462	-0.470	-0.475
	-50.078**	-5.103**	-51.362**	- 5.258**	-5.103**	-5.338**
LEX	-0.151	-0.151	-9.717***	5.409	-0.990	0.055
	-6.290**	8.300**	-18.356**	-49.915**	-46.976**	-12.571**

L=Level, D=First difference, *and** denote ADF and ADF-GLS statistical significance at 1% level, respectively. *** Denotes ADFand ADF-GLS statistical significance at 1% level for log level of Exchange rate for Saudi Arabia. ADF test statistic at 1%=-3.433 and DF-GLS test statistic at 1%=-2.566. LSP=Stock Price, LOILP=Crude Oil Price and LEX=Exchange Rate.

Table 2: Cointegration Test Results

Selected Major Oil Producers					
Mexico	Hypothesized No. of CE9s)	Max-Eigen Statistics	0.05 Critical Value	Trace Statistic	0.05 Critical Value
	None	18.931	25.823	43.191*	42.915
	At most 1	16.740	19387	24.260	25.872
	At most 2	7.520	12.518	7.520	12.517
Russia	Hypothesized No. of CE9s)	Max-Eigen Statistics	0.05 Critical Value	Trace Statistic	0.05 Critical Value
	None *	55.57897	25.82321	84.54206	42.91525
	At most 1 *	21.74567	19.38704	28.96310	25.87211
	At most 2	7.217424	12.51798	7.217424	12.51798
Saudi Arabia	Hypothesized No. of CE9s)	Max-Eigen Statistics	0.05 Critical Value	Trace Statistic	0.05 Critical Value
	None *	126.7492	21.13162	136.4348	29.79707
	At most 1	7.105327	14.26460	9.685564	15.49471
	At most 2	2.580237	3.841466	2.580237	3.841466
Selected Major Oil Consumers					
China	Hypothesized No. of CE9s)	Max-Eigen Statistics	0.05 Critical Value	Trace Statistic	0.05 Critical Value
	None *	63.75181	21.13162	67.77212	29.79707
	At most 1	3.995822	14.26460	4.020317	15.49471
	At most 2	0.024495	3.841466	0.024495	3.841466
India	Hypothesized No. of CE9s)	Max-Eigen Statistics	0.05 Critical Value	Trace Statistic	0.05 Critical Value
	None *	29.95613	21.13162	34.80625	29.79707
	At most 1	4.841037	14.26460	4.850112	15.49471
	At most 2	0.009075	3.841466	0.009075	3.841466
USA	Hypothesized No. of CE9s)	Max-Eigen Statistics	0.05 Critical Value	Trace Statistic	0.05 Critical Value
	None *	24.03798	21.13162	29.86418	29.79707
	At most 1	5.285906	14.26460	5.826199	15.49471
	At most 2	0.540293	3.841466	0.540293	3.841466

Max-Eigen and Trace Statistics test suggest 1 cointegrating equation for most countries (except Russia with two and Mexico with none). *denote rejection of the hypothesis at the 0.05

Table 3: Cointegration Analysis of Selected Major Oil Producers

Country	Variables	C. Vector	Adj. Coef.	Test of Exclusion from CE (β=0)	Test of Weak Exog (a=0)
Russia	LSP	1.000	0.002	27.464	4.658
			(0.002)	(0.000)	(0.097)
		0.000	-0.007		
			(0.003)	(0.003)	
	LOILP	0.000	0.006	23.141	12.176
			(0.002)	(0.000)	(0.002)
		1.000	-0.008		
			(0.003)		
	LEX	4.267	-0.001	31.553	47.431
		(0.644)	(0.000)	(0.000)	(0.000)
		1.779	-0.002		
		(0.380)	(0.001)		
	Trend	-0.001			
		(0.000)			
		-0.001			
		(0.000)			
Saudi Arabia					
	LSP	1.000	0.0003	1.811	10.175
			(0.000)	(0.178)	(0.001)
	LOILP	-2.656	0.0003	6.200	3.852
		(0.800)	(0.0001)	(0.013)	(0.050)
	LEX	-5193.992	0.0001	118.924	108.505
		(507.217)	0.0000	(0.000)	(0.000)
		Selected Major Oil Consumers			
China	LSP	1.000	-0.001	16.549	0.746
			(0.001)	(0.000)	(0.388)
	LOILP	1.220	-0.001	30.995	0.800
		(0.214)	(0.001)	(0.000)	(0.371)
	LEX	5.7813	-0.0002	13.251	58.989
		(1.384)	(0.000)	(0.000)	(0.000)
India					
	LSP	1.000	-0.002	17.285	1.576
			(0.001)	(0.000)	(0.209)
	LOILP	-1.548	0.009	24.631	21.055
		(0.136)	(0.002)	(0.000)	(0.000)
	LEX	-2.475	-0.001	4.105	3.245
		(1.120)	(0.000)	(0.043)	(0.072)
USA					
	LSP	1.000	0.001	5.337	1.806
			(0.001)	(0.021)	(0.179)
	LOILP	-1.648	0.008	18.465	18.734
		(0.307)	(0.002)	(0.000)	(0.000)
	LEX	-5.292	0.001	17.793	2.111
		(1.086)	(0.000)	(0.000)	(0.146)

Normalized cointegration coefficients (standard error in parenthesis), adjustment coefficients (standard error in parentheses) , test for long-run exclusion and Weak exogeneity-chi-sq and (probability in parentheses), LSP=Stock Price, LOILP=Crude Oil Price and LEX=Exchange Rate.

Table 4: VECM Pairwise Granger Causality Test

Selected Major Oil Producers												
Mexico		**Dep. Variable**			**Russia**	**Dep. Variable**			**Saudi Arabia**		**Dep. Variable**	
Excluded Variables	**LSP**	**LOILp**	**LEX**	**BXO**	**LSP**	**LOILp**	**LEX**	**BXO**	**LSP**	**LOILp**	**LEX**	**BXO**
LSP		21.04	15.01	35.15		5.22	7.45	17.18		21.56	21.64	43.40
		(.00)	(.00)	(.00)		(.07)	(0.02)	(.00)		(.00)	(.01)	(.00)
LOilp	13.67		0.04	15.52	24.93		0.19	25.73		14.09	12.15	26.19
	(.00)		(.82)	(.00)	(.00)		(.91)	(0.00)	(.05)		(.10)	(.02)
LEX	416.85	2.93		418.07	10.41	13.51		31.63	24.05	10.40		34.75
	(.00)	(.23)		(.00)	(.01)	(.00)		(.00)	(.00)	(.17)		(.00)
Selected Major Oil Consumers												
China					**India**				**USA**			
LSP		0.08	0.07	0.10		0.53	0.39	0.72		12.14	30.31	39.67
		(0.78)	(0.79)	(0.95)		(0.48)	(0.53)	(0.70)		(0.01)	(0.00)	(0.00)
LOilp	2.29		0.10	2.50	15.93		7.09	23.33	20.69		16.62	33.50
	(0.13)		(0.75)	(0.29)	(0.00)		(0.01)	(0.00)	(0.00)		(0.00)	(0.00)
LEX	17.13	28.54		49.83	7.35	6.63		7.52	24.71	32.23		59.61
	(0.00)	(0.00)		(0.00)	(0.01)	(0.01)		(0.02)	(0.00)	(0.00)		(0.00)

VECM Granger causality test and Block Exogeneity (BXO) Wald tests. Both the chi-sq and (probability in parenthesis) are reported. LSP=Stock Price, LOILP=Crude Oil Price and LEX=Exchange Rate, Dep. Variable=Dependent Variable and BXO=Block Exogeneity.

Table 5: Impulse Response

Selected Major Oil Producers

Days Shock		**Mexico**		**Russia**			**Saudi Arabia**		
	LSP	**LOILP**	**LEX**	**LSP**	**LOILP**	**LEX**	**LSP**	**LOILP**	**LEX**
				Response of Stock Prices to innovations in					
1	0.015	0.000	0.000	1.000	0.000	0.000	1.000	0.000	0.000
5	0.017	0.002	0.001	1.031	0.036	-0.180	1.114	0.062	-1.268
30	0.016	0.001	0.002	1.057	-0.015	0.356	1.068	0.058	-20.867
60	0.015	0.001	0.004	1.077	-0.063	0.967	1.068	0.018	-21.616
90	0.014	0.001	0.005	1.085	-0.101	1.538	1.068	0.018	-21.616
				Response of Crude Oil Prices to innovations in					
1	0.000	0.027	0.000	0.000	1.000	0.000	0.000	1.000	0.000
5	0.000	0.025	-0.000	0.071	0.922	-0.076	0.062	0.974	1.592
30	0.004	0.019	-0.000	0.207	0.692	-0.068	0.160	0.798	-13.532
60	0.006	0.014	0.000	0.330	0.482	0.041	0.231	0.695	-14.074
90	0.008	0.010	0.001	0.420	0.327	0.223	0.291	0.602	-14.020
				Response of Exchange Rate to innovations in					
1	0.000	0.000	0.006	0.000	0.000	1.000	0.000	0.000	1.000
5	-0.003	-0.000	0.006	-0.012	-0.013	1.163	0.001	-0.000	0.642
30	-0.002	-0.001	0.005	-0.020	-0.013	1.072	0.000	-0.000	0.044
60	-0.002	-0.001	0.005	-0.028	-0.013	0.967	0.000	-0.000	0.002
90	-0.001	-0.001	0.005	0.420	0.327	0.223	0.000	-0.000	0.002

Selected Major Oil Consumers

Days after Shock			**China**			**India**		**USA**		
	LSP	**LOILP**	**LEX**	**LSP**	**LOILP**	**LEX**	**LSP**	**LOILP**	**LEX**	**LSP**
					Response of Stock Prices to innovations in					
1	1.000	0.000	0.000		1.000	0.000	0.000	1.000	0.000	0.000
5	0.997	-0.001	-0.008		0.997	-0.001	-0.008	0.860	-0.033	-0.229
30	0.977	-0.008	-0.059		0.977	-0.008	-0.058	0.817	-0.065	-0.363
60	0.954	-0.015	-0.115		0.954	-0.015	-0.015	0.762	-0.085	-0.465
90	0.931	-0.021	-0.169		0.931	-0.021	-0.169	0.734	-0.096	-0.520
				Response of Crude Oil Prices to innovations in						
1	0.000	1.000	0.000		0.000	1.000	0.000	0.000	0.000	1.000
5	0.011	0.990	0.015		0.011	0.990	0.015	-0.033	-0.024	0.948
30	0.076	0.931	0.104		0.076	0.931	0.104	-0.016	-0.032	0.909
60	0.954	-0.015	-0.115		0.146	0.864	0.196	0.002	-0.040	0.871
90	0.931	-0.021	-0.169		0.209	0.800	0.273	0.017	-0.045	0.840
				Response of Exchange Rate to innovations in						
1	0.000	0.000	1.000		0.000	0.000	1.000	0.000	1.000	0.000
5	-0.000	-0.001	0.995		-0.001	-0.001	0.995	0.054	0.907	-0.043
30	-0.006	-0.006	0.967		-0.006	-0.006	0.967	0.197	0.679	-0.859
60	-0.012	-0.012	0.933		-0.012	-0.012	0.934	0.294	0.487	-1.538
90	-0.019	-0.018	0.900		-0.019	-0.018	0.900	0.334	0.359	-1.986

Source: Computation by the author. LSP=Stock Prices, LOILP=Crude Oil Price and LEX=Exchange Rate.

Table 6: Variance Decomposition

Days Ahead	Mexico				Russia				Saudi Arabia			
	Selected Major Oil Producers											
	LSP	LOILP	LEX	SE	LSP	LOILP	LEX	SE	LSP	LOILP	LEX	SE
	How much does Crude Oil Prices explain?											
1	0.012	99.988	0.001	0.027	0.629	99.371	0.000	0.027	0.005	99.995	0.000	0.027
5	0.032	99.967	0.001	0.058	1.656	98.336	0.008	0.058	0.170	99.800	0.030	0.059
15	0.274	99.722	0.004	0.096	2.846	97.140	0.014	0.095	0.408	99.146	0.445	0.095
30	1.078	98.915	0.008	0.126	5.022	94.962	0.017	0.125	0.796	97.772	1.432	0.129
60	4.036	95.956	0.008	0.157	11.131	88.857	0.013	0.158	1.721	95.761	2.517	0.171
	How much does Exchange Rate explain?											
1	1.144	0.225	98.631	0.006	0.882	0.418	99.494	0.004	0.000	0.027	99.973	0.000
5	19.640	0.340	80.020	0.014	0.871	1.610	97.519	0.010	0.198	0.057	99.745	0.001
15	21.702	0.645	77.652	0.024	1.208	1.868	96.924	0.017	0.527	0.223	99.250	0.001
30	21.133	1.100	77.768	0.033	1.590	2.000	96.410	0.024	0.582	0.447	98.971	0.001
60	19.223	2.117	78.660	0.045	2.495	2.149	95.356	0.032	0.586	0.703	98.711	0.001
	Selected Major Oil Consumers											
	China				India				USA			
	How much does Crude Oil Prices explain?				How much does Crude Oil Prices explain?							
1	0.097	99.903	0.000	0.028	0.097	99.903	0.000	0.028	2.216	97.784	0.000	0.027
5	0.077	99.923	0.000	0.061	0.077	99.923	0.000	0.061	3.074	96.911	0.015	0.057
15	0.042	99.958	0.000	0.105	0.042	99.958	0.0000	0.105	3.723	96.089	0.189	0.093
30	0.027	99.972	0.000	0.145	0.027	99.972	0.000	0.145	5.004	93.907	1.089	0.123
60	0.133	99.866	0.001	0.198	0.133	99.866	0.001	0.198	7.664	87.484	4.853	0.158
	How much does Exchange Rate explain?											
1	0.007	0.000	99.993	0.001	0.001	0.000	99.993	0.001	0.467	0.846	98.687	0.005
5	0.035	0.042	99.923	0.002	0.035	0.042	99.924	0.002	2.927	3.792	93.281	0.011
15	0.199	0.487	99.313	0.003	0.199	0.487	99.313	0.003	3.083	5.111	91.806	0.018
30	0.708	1.989	97.303	0.004	0.708	1.989	97.303	0.004	2.761	6.065	91.175	0.025
60	2.611	7.230	90.159	0.006	2.610	7.230	90.159	0.006	2.109	7.634	90.258	0.035

Source: Computation by the author. LSP=Stock Prices, LOILP=Crude Oil Price and LEX=Exchange Rate.

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