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THE EFFECTS OF OIL PRICE ON ASIA – PACIFIC EXCHANGE RATES: EVIDENCE FROM QUANTILE REGRESSION ANALYSIS

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Abstract

An attempt has been made in this paper, to investigate the effect of oil prices on the exchange rate of 13 Asia – Pacific sample countries against USD, for the period from 04th January 2000 to 31st March 2020. OLS and QR Models were adopted for the analysis. Japanese Yen and Hong Kong Dollar were not affected by the oil prices during the study period. Sample currencies responded differently to oil price shocks under current market conditions. The results of this study would be useful to the policy makers, in the context of variations of oil and currency markets.

Keywords: *Oil Price, Exchange Rate, Quantile Regression*

1. Introduction

In the financial literature, the nexus between the exchange rate and oil price is widely discussed. Whenever there is a decline in the oil price, there is devaluation in the currency of oil-exporting economies. In other words, the interrelation between the price of oil and exchange rate causes great concern. The oil price shocks are caused by economic variables. The notable causes for macroeconomic fluctuations are mainly due to oil shocks. Therefore, the prediction of the volatility of oil prices is considered a critical research issue **(Volkov, N. I., 2016, Youssef, M., 2020).** The oil prices could affect the exchange rates through different channels and it affects many domestic economic indicators like GDP, inflation, investment, economic growth, interest rates of both oil-exporter and oil-importer countries. It is to be noted that changes in the market fundamentals amplify the volatility of exchange rates. Besides, the majority part of international oil transactions are invoiced in U.S Dollar. Hence the oil price changes induced the inflow or outflow of oil dollars, which would affect the exchange rates of oil-exporting and oil-importing countries.

The complexity of oil price and the exchange rates dynamic requires more sophisticated approaches to understand the strength, and significance of the relationship between oil and currency markets. In the finance literature, many studies have already employed linear models **(Huang and Guo, 2007; Méndez-Carbajo, 2011; Brahamsrene et al., 2014; Habib et al., 2016; Pershin et al., 2016; Al Rasasi, 2017),** On the other hand, the other research works by **Benhmad (2012); Basher et al. (2016);**

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Coudert and Mignon (2016) and Wen et al. (2017) concentrated on the nonlinear models. It is significant to note that earlier studies examined the influence of oil price shocks on financial market in terms of market returns. But majority of these studies neglected the classification of heterogeneity of returns of the exchange rate **(Su et al., 2016)**. By using the Quantile Regression Methodology, **Nusair and Olson (2019)** demonstrated that the oil price shocks lead to asymmetrical exchange rate returns, that differ in implication, size and sign, all through the distribution of exchange rate returns. The Quantile Regression (QR) Model caused concern in financial and economic fields because it approved. It approves the consideration of explanatory variables on the dependent variable, at different quantiles of the dependent variable's conditional distribution **(Koenker, R., 1978; Youssef. M**, **2000)**.
Some recent studies employed QR Model to know the relationship between financial variables, e.g., trading volume and return volatility **(Chuang et al., 2009)**. Besides, the Quantile Regression Models was also used to analyze the relationship between Oil and Stock **(Nusair, S. A., 2018; You et al., 2017; Zhu et al., 2015; Sim and Zhou, 2015; Mensi et al; 2014 and Lee and Zeng, 2011)**.

Oil- importing (exporting) economy always encounters the depreciation or appreciation of currency, in response to every change in the oil prices **(Golub, 1983)**. Acceleration of real oil prices negatively affects the trade balance for an oil-importing country, which may require real currency depreciation to improve the country's competitiveness **(Zhou, 1995).** Against this background, the aim of this paper was to investigate the effect of oil price on exchange rates.

2. Review of Literature

In financial literature, there are many studies, focusing on the impact of oil price on the exchange rate across the globe. This section reviews the previous research works, in the area of oil price and exchange rates.

Table-1 shows the existing literature, related to oil price and exchange rate.

The below literature provides the overview of selected empirical studies, already undertaken in the same lines of the present research. But only few studies have focused on the effects of oil price on Asia – Pacific exchange rates, by using the Quantile Regression Analysis. Hence the present study on the effects of oil price on Asia –Pacific exchange rates, using the Quantile Regression Analysis.

Table – 1: Review of selected literature relating to Oil Price and Exchange Rates

Author(s)	Purpose	Data period	Methodology	Main Findings
Baur, D., (2005)	This paper investigates the occurrences and degree of exceedance of the financial market.	Daily data from 30th April 1997 to 31st October 2001	Descriptive Statistics, Correlation and Quantile Regression Model	This study influences the exceedance across the regions and there were contagion from Asia, Latin America, and Europe but not in the United States.
Chuang, C. (2009)	This author examines the causal relations between stock return and volume based on Quantile Regressions.	Daily observations from January 4, 1990, to June 30, 2006	Descriptive Statistics, Wald Test and Quantile Regression test	The quantile causal effects were assorted across the quantiles but, the causal effects at tail quantiles varied from middle quantiles.
Akram, Q.F. (2009)	The paper investigates the was decline contributes to higher commodity prices	Quarterly observations from Q1 1990 to Q4 2007	VAR Structural Model	Stimulation of commodity prices along with crude oil raised the value due to the depreciation of the US dollar.
Aloui, R., (2013)	This study examines the conditional dependence structure between Crude oil and Exchange Rate	Daily data from January 4, 2000, to February 17, 2011.	Descriptive Statistics, GARCH, Correlation, Copula Models,	Japan-WTI and Japan - Brent provide significant evidence for the symmetric tail.
Baur, D. G. (2013)	The author of this article estimates the dependence of equity stocks and commodities	Daily observations from January 4, 1994, to March 10, 2011.	Descriptive Statistics and Quantile Regression Model	The estimation results show that there were negative changes in the degree of dependence.
Chen .H (2016)	This study examines the impact of oil prices on the bilateral exchange rate of 16 OECD countries.	Monthly observations from January 1990 to December 2014	Unit Root Test, Cointegration Test, Asymmetry Test, Non-Linearity Causality Test	The oil price shocks comprehensively clarified about 10% of the short-term exchange rate variations and about 20% of the long-term exchange rate variations.
Volkov, N. I (2016)	This research article investigates the effect of oil prices on exchange rate movements on oil-exporting countries.	Monthly frequency from September 1998 to August 2012	Correlation, Variance Inflation Factors, Baseline Model, GARCH-M Model, Cointegration, VECM and Granger Causality test	Exchange Rate fluctuations of Russia, Brazil, and Mexico were significant in response to oil price shock. Norway and Canada failed to attain a significant level.
Lee, C.C (2017)	This paper investigates the impact of variations in real oil prices on the real stock returns of G7 countries.	Monthly data from January 1975 to December 200p	Structural Break Test, Asymmetric Effect	Asymmetric effect shows that oil price shocks impacted the real stock returns under the intensive practice of stock markets
Nusair, S. A (2018)	The paper studies the effects of oil prices shocks on Asian Exchange Rates	Quarterly data from Q2 of 1973 to Q4 2016	Descriptive Statistics, Unit Root Test, OLS and QR Approach	The currencies responded differently to oil price shocks under FOREX market conditions and the impact of appreciation or depreciation of oil prices

				on foreign exchange markets varied by country and market conditions.
Amirdha Vasani S (2020)	This article investigates the efficiency of Asia – Pacific Foreign Exchange Market	Daily observations from 02/01/2010 to 31/12/2019	Descriptives statistics, Unit Root Test, Residual Diagnostics, Wild Bootstrap test	The study found that AUD and CNY were the currencies which rejected the Martingale Differecnce Hypothesis. Other samples currencies had fallen under weak form of effeicency market.
Youssef, M (2020)	This article examines the impact of oil price on oil-exporting economies' exchange rate	Daily data from 4th January 2000 to 31st December 2018	Descriptive Statistics. Unit Root Test and Correlation	All sample countries, except Japan, showed the tragic development of interdependence of oil on the exchange rate of sample countries.

3. Methodology

Table – 2: Methodology used in existing literature

Objectives	Hypotheses	Tools
To examine the normality and stationarity in oil price and exchange rate of Asia – Pacific countries	**NH_1:** There is no normality and stationarity in oil price and exchange rate of Asia – Pacific countries	i) Descriptive Statistics ii) Unit Root Test
To investigate the linear relationship between oil price and exchange rate of Asia – Pacific countries	**NH_2:** There is no linear relationship between oil price and exchange rate of Asia – Pacific countries	Correlation
To study the effect of oil price on the exchange rate of Asia – Pacific countries	**NH_3:** There is no effect of oil price on the exchange rate of Asia – Pacific countries	i) OLS ii) Quantile Regression Model

4. Sample Selection and Data Collection

This study exaamined on the effects of oil price on the Asia – Pacific Foreign Exchange Rates against USD, using daily data for the period from January 4, 2000, to March 31, 2020. There are 47 countries in Asia – Pacific region and the required data were available only for 13 countries. Hence this study used the 13 sample currencies in Asia –Pacific region and those sample currencies included Australian Dollar (AUD), Chinese Renminbi (CNY), Hong Kong Dollar (HKD), Indonesian Rupiah (IDR), Indian Rupee (INR), Japanese Yen (JPY), South Korean Won (KRW), Malaysian Ringgit (MYR), New Zealand Dollar (NZD), Philippines Peso (PHP), Singapore Dollar (SGD), Thailand Bhatt (THB) and Taiwan Dollar (TWD) against USD. Data on Exchange Rate were extracted from Pacific Exchange Rate Services and the data of oil price were obtained from the US Energy Information Administration website. The exchange rate for the given sample currencies was expressed as the number of units of local currency needed to purchase one U.S.Dollar.

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5. Empirical Analysis and Findings

Table – 3: Results of Descriptive, Unit Root Test and Correlation Statistics on the Oil Price and Exchange Rate of Sample Asia-Pacific Currencies

	AUD	*CNY*	*HKD*	*IDR*	*INR*	*JPY*	*KRW*	*MYR*	*NZD*	*PHP*	*SGD*	*THB*	*TWD*	*XCB*
Mean	0.0000	0.0000	0.0000	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003
Median	-0.0001	0.0000	0.0000	0.0001	0.0000	0.0001	-0.0001	0.0000	-0.0001	0.0000	-0.0001	-0.0001	0.0223	-0.0004
Max	0.0856	0.0187	0.0000	0.0993	0.0407	0.0337	0.1081	0.0208	0.0576	0.0471	0.0271	0.0457	-0.0263	0.2907
Min	-0.0740	-0.0206	0.0000	-0.0937	-0.0350	-0.0429	-0.1041	-0.0352	-0.0576	-0.1177	-0.0237	-0.0317	0.0029	-0.1658
S.D.	0.0081	0.0015	0.0000	0.0077	0.0043	0.0063	0.0069	0.0036	0.0083	0.0044	0.0033	0.0038	-0.2115	0.0240
Skewness	0.7297	-0.1672	0.0000	0.7502	0.3901	-0.1722	0.5428	-0.2936	0.4039	-3.4943	0.0193	0.3967	10.1799	1.0330
Kurtosis	15.1488	32.9648	72.1393	26.4815	12.3366	6.3948	40.8895	10.5067	7.6633	114.6888	8.0624	15.4395	10604.75	14.833
JB	30693	184090.1	983194	113494.1	17994.98	2386.83	294542	11622.39	4591.782	2567263	5254.1020	31850.81	10604.75	29580.6
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ADF	-72.7986	-69.8715	-54.2257	-28.9370	-33.5740	-71.2537	-51.7780	-68.2329	-69.8990	-43.4744	-71.2776	-68.1057	-71.6361	-68.514
PP	-72.7986	-71.6542	-74.3184	-79.2776	-70.8706	-71.2799	-69.8290	-68.5614	-69.9164	-76.3062	-71.2706	-68.1636	-71.6557	-69.298
Correlation	0.2786	0.0998	0.0194	0.1020	0.1358	-0.07077	0.1521	0.1852	0.2254	0.1251	0.2244	0.1054	0.1391	1

Source: Pacific Exchange Rate services and Energy Information Administration

Note: AUD - Australian Dollar, CNY - Chinese Renminbi, HKD - Hong Kong Dollar, IDR - Indonesian Rupiah, INR - Indian Rupee, JPY - Japanese Yen, KRW - South Korean Won, MYR - Malaysian Ringgit, NZD - New Zealand Dollar, PHP -Philippines Peso, SGD - Singapore Dollar, THB - Thailand Bhatt and TWD - Taiwan Dollar

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Table-3 provides the results of descriptive, unit root test and correlation statistics, for oil price and exchange rate returns of thirteen Asia – Pacific economies, during the sample period from 04/01/2000 to 31/03/2020. It is clear from **Table – 3** that the oil price recorded the highest mean value (0.0003), followed by Indonesian Rupiah (0.0002) and Indian Rupee (0.0001). The other eleven sample currencies reported low mean values (0.0000) during the study period. It is to be noted that the oil price (0.0240) reported high deviation values in all the sample countries during the sample period. Hong Kong dollar (0.0000) recoeded a low standard deviation compared to the other foreign exchange currencies. Further, it was found that majority of series, except Chinese Renminbi (-0.1672), Japanese Yen (-0.1722), Malaysian Ringgit (-0.2936) and Philippines Peso (-0.4943), showed positive skewness, which implied that the return series was skewed to the right. The oil price and returns of every currency have recorded a high degree of kurtosis by showing higher value than that of statistic value of 3; and indicated a leptokurtic distribution of data and had fatter tails than the normal distribution. P-value of descriptive statistics revealed that oil price and exchange rate returns followed a price of normal distribution of data during the study period.

The results of the Unit Root Test (ADF & PP), for the daily return of exchange rate and oil price return, during the sample period are also given in **Table-3.** The p-values of ADF and PP test for the return of oil price and exchange rate series, were recorded as 0.0000. The statistical value of the ADF test showed that AUD (-72.7986) recorded the lowest values compared to other oil price returns and sample currencies. IDR (-28.9370) reported the highest value among sample currencies in ADF. In the PP test, IDR (-79.2776) recorded the lowest value and THB (-68.1636) reported the highest value among the oil price returns and sample currencies. Hence, the null hypothesis (NH_{01}) namely, "**there is no normality and stationarity in oil price and exchange rate of Asia – Pacific countries,**" was rejected.

According to the results of **Table – 3,** there was correlation between exchange rate return and oil price return during the study period. Among 13 currencies with their oil prices, the Japanese Yen (-0.07077) was the only currency that attained a negative correlation, among the other sample currencies during the study period. Australian Dollar (0.2786) recorded the highest correlation in exchange rate returns with oil price returns and also all the sample currencies attained significant values, at 5%, with oil prices.

Table – 4: The Estimation Results from the OLS and Quantile Regression Models for oil prices and sample currencies during the study period

Sample currencies	OLS	Bearish Market			Normal Market			Bullish Market		
		$Q_{0.1}$	$Q_{0.2}$	$Q_{0.3}$	$Q_{0.4}$	$Q_{0.5}$	$Q_{0.6}$	$Q_{0.7}$	$Q_{0.8}$	$Q_{0.9}$
AUD	**0.8240 (0.0000)**	**0.8095 (0.0000)**	**0.6951 (0.0000)**	**0.6909 (0.0000)**	**0.6663 (0.0000)**	**0.7247 (0.0000)**	**0.7719 (0.0000)**	**0.8096 (0.0000)**	**0.8121 (0.0000)**	**0.8587 (0.0000)**
CNY	**1.6514 (0.0000)**	**1.1582 (0.0013)**	**1.0943 (0.0024)**	**1.0958 (0.0000)**	**0.9084 (0.0000)**	**1.1209 (0.0000)**	**1.0287 (0.0000)**	**1.1379 (0.0000)**	**1.7733 (0.0000)**	**1.6586 (0.0000)**
HKD	**1.2382 (0.1729)**	**3.0421 (0.1697)**	**2.6617 (0.0441)**	**3.7785 (0.0440)**	**2.8634 (0.0065)**	**1.8323 (0.0823)**	**1.7002 (0.1415)**	**1.7770 (0.0511)**	**2.8303 (0.0003)**	**3.0877 (0.1227)**
IDR	**0.3193 (0.0000)**	**0.1690 (0.0011)**	**0.2264 (0.0018)**	**0.2279 (0.0000)**	**0.2304 (0.0000)**	**0.2317 (0.0000)**	**0.2481 (0.0000)**	**0.2727 (0.0000)**	**0.3222 (0.0000)**	**0.4148 (0.0000)**
INR	**0.7614 (0.0000)**	**0.5849 (0.0002)**	**0.5995 (0.0000)**	**0.5705 (0.0000)**	**0.4739 (0.0000)**	**0.4356 (0.0000)**	**0.5579 (0.0000)**	**0.6994 (0.0000)**	**0.9165 (0.0000)**	**1.0560 (0.0000)**
JPY	**-0.2680 (0.0000)**	**-0.1058 (0.2546)**	**-0.1312 (0.0763)**	**-0.1134 (0.0800)**	**-0.1341 (0.0224)**	**-0.1450 (0.0095)**	**-0.1414 (0.0109)**	**-0.2209 (0.0006)**	**-0.2647 (0.0002)**	**-0.5073 (0.0000)**
KRW	**0.5308 (0.0000)**	**0.5846 (0.0000)**	**0.5350 (0.0000)**	**0.5161 (0.0000)**	**0.5297 (0.0000)**	**0.4501 (0.0000)**	**0.5192 (0.0000)**	**0.5989 (0.0000)**	**0.5755 (0.0000)**	**0.5584 (0.0000)**
MYR	**1.2468 (0.0000)**	**0.9856 (0.0000)**	**0.5485 (0.0000)**	**0.8030 (0.0000)**	**0.8125 (0.0000)**	**0.8207 (0.0000)**	**0.8548 (0.0000)**	**1.1421 (0.0000)**	**1.3796 (0.0000)**	**1.5038 (0.0000)**
NZD	**0.6482 (0.0000)**	**0.5571 (0.0000**	**0.5630 (0.0000)**	**0.5354 (0.0000)**	**0.5088 (0.0000)**	**0.5384 (0.0000)**	**0.5806 (0.0000)**	**0.6156 (0.0000)**	**0.6456 (0.0000)**	**0.6683 (0.0000)**
PHP	**0.6787 (0.0000)**	**0.4941 (0.0001)**	**0.527 (0.0001)**	**0.4735 (0.0000)**	**0.5258 (0.0000)**	**0.5013 (0.0000)**	**0.6072 (0.0000)**	**0.6987 (0.0000)**	**0.7415 (0.0000)**	**0.8240 (0.0000)**
SGD	**1.6197 (0.0000)**	**1.7343 (0.0000)**	**1.3901 (0.0000)**	**1.3080 (0.0000)**	**1.1763 (0.0000)**	**1.1631 (0.0000)**	**1.2706 (0.0000)**	**1.3842 (0.0000)**	**1.5477 (0.0000)**	**1.8212 (0.0000)**
THB	**0.6679 (0.0000)**	**0.4368 (0.0054)**	**0.4544 (0.0000)**	**0.4020 (0.0000)**	**0.3985 (0.0000)**	**0.3720 (0.0000)**	**0.4603 (0.0000)**	**0.5654 (0.0000)**	**0.5769 (0.0000)**	**0.8812 (0.0000)**
TWD	**1.1517 (0.0000)**	**1.0635 (0.0000)**	**1.0674 (0.0000)**	**0.9062 (0.0000)**	**0.9515 (0.0000)**	**0.7704 (0.0000)**	**0.9969 (0.0000)**	**1.1067 (0.0000)**	**1.2219 (0.0000)**	**1.3741 (0.0000)**

Source: Pacific Exchange Rate services and Energy Information Administration

Note: This study estimate the QR model for nine quantiles (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9) and divide them into three regimes: quantiles (0.1, 0.2, 0.3)corresponds to a bearish market (large USD appreciation), quantiles (0.4, 0.5, 06) corresponds to a normal market and quantiles (0.7, 0.8, 0.9)which corresponds to a bullish market (large USD appreciation).

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Therefore, the null hypothesis (NH_{02}) namely, "**there is no linear relationship between oil price and exchange rate of Asia – Pacific countries,**" was not accepted.

Table-4 represents the estimation of the results of both the OLS and QR Models for oil price and sample currencies, during the study periof from January 4, 2000 to March 31, 2020. The results of OLS revealed that the oil price did have significant impact on the currency rates of all the sample countries, except Japan (-0.2680). Hong Kong Dollar was the only currency, that showed no impact of its oil price on the exchange rate.

In other words, oil price did have direct link to the currencies of sample countries, except Japan and Hong Kong, against USD. In Japan, the oil price created no significant impact on the Japanese Yen. From the QR analysis, as shown in **Table -4,** it is inferred that there was information on the effect of oil price on the exchange rate in Asia – Pacific countries. The quantiles are one of the measures, to study the impact of the oil price on the exchange rate. From the analysis, Quantiles (0.1, 0.2,0.3,0.4,0.5,0.6,0.7,0.8,0.9) were classified under three heads as Bearish Market (0.1,0.2 and 0.3), Normal Market (0.4,0.5 and 06) and Bullish Market (0.7,0.8 and 0.9). Bearish Market represents low quantiles and Bullish Market represents higher quantiles.

According to the analysis of Lower, Normal and Higher Quantiles, Japan was the only country, which recorded a negative impact of oil price on Japanese yen against USD. The results of Japan indicated that oil prices have no significant impact on the exchange rate at all quantiles. As far as the Hong Kong dollar was concerned, oil price had no significant effect on the exchange rate at lower quantiles (0.2), normal quantiles (0.5, 0.6) and higher quantile (0.9). The findings from the QR model as given in **Table -4** revevaled that oil prices have an impact on the exchange rate on majority of Asia – Pacific exchange rates, by responding to oil price during periods of currency appreciation or depreciation. Hence the null hypothesis (NH_{03}) namely, **"there is no effect of oil price on the exchange rate of Asia – Pacific countries,"** was rejected.

6. Conclusion

The volatility of the oil market generally induced active involvement among market participants and policymakers. According to the findings of previous literature, the response of exchange rates against the US dollar differed and the exchange rate monthly depends on the variations of oil prices. This paper investigated the effect of daily crude oil prices and Asia – Pacific Countries on the exchange rates, against USD, using Quantile Regression Approach. Out of 13 sample currencies, only two currencies, namely, Japanese Yen and Hong Kong Dollar were not influenced by oil prices during the study period. The findings of this study concurred with the findings of previous studies, by **Lizardo, R.A (2010), Chinn, M. D. (2000), and Wang, P., (2000),** who found that rising of oil prices caused currency depreciation for Japan. In contrast, the findings of Indonesia was not in line with those of **Turhan et al. (2013), Chinn, M. D. (2000), and Wang, P., (2000)** who found that a rise in oil prices caused currency appreciation for Indonesia. This study also found that the oil price shocks generally did not have significant impact on their exchange rates and this fnding is in contrary to that of **Turhan, M. I., (2014)** The existence of financial effects between oil and currency markets implied that Governments and Policymakers should take appropriate measures, to stabilize the currency markets, by adjusting interest rates, adjusting information disclosure, etc. to stablise the local currency rate.

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