An empirical analysis of oil price and exchange rate: evidence from the selected oil exporting and oil importing countries

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Abstract

This study investigates the impact of oil price on the exchange rate by incorporating the economic indicators (Inflation, Money supply, and Net trade), financial indicators (Interest rate and Stock market index) and US factor (Implied volatility index), the researcher attempts to identify the relationship among these variables on the exchange rate. The Ordinary least square method was performed to meet the purpose of this study by using the monthly time series data technique for the period August 2005 to December 2016 and the sample countries are selected from oil-exporting (Russia, Canada, and Malaysia) and oil-importing countries (China, India, and Japan). The findings reveal that an increase in oil price oil-exporting countries (Russia, China, and Malaysia) currency will appreciate and oil-importing (China and India) countries will also appreciate except Japan currency. The evidence from China and India portray a theory that developed by Krugman (1983) and Golub (1983) where an increase in the oil price oil-importing countries experience appreciation in the exchange rate and vice versa due to wealth transfer. Thus, in order to formulate and implementing economic policies the government should consider the impact of oil price specially the exchange rate policies since the impact is significant.

Introduction

Oil price is subjected to change by several factors and lead the world economy to move in different direction for both oil-importing and oil-exporting countries. It is also can lead to a domino effect on macroeconomics and financial variables, especially on the exchange rate fluctuation. The empirical evidence stated that as an increase in the oil price would affect the economic and financial condition to change in many ways. Basically, any changes (increase) in oil price would affect the country's wealth through the trade channel by transferring the wealth from oil importing to the exporting countries. Hence, the exchange rate would fluctuate as the oil prices increase or decrease (Tuhan et al, 2013). Generally, research on oil price has been found a mixed result with regards to its different effect on the exchange rate movement experienced in both oil importers and exporters countries (Zalduendo, 2006; Kutan and Wyzan, 2005; Koranchelian, 2005; Spatafora and Stavrev, 2003; Lizardo and Mollick, 2010; Akram, 2004; Habib and Kalamova, 2007; Bjornland and Hungnes, 2008; Gauthier and Tessier, 2002). Apart from the debate, the impact of oil price on the exchange rate was found not consistent with the theory introduced by Golub (1983) and Krugman (1983) namely Trade Channel Impact and suggested that oil exporting countries would experience appreciation in currency if the oil price increase.

Apart from the focus variable (Oil Price), economic and financial variables also would directly contribute to the relationship towards the exchange rate. Economic variables such as Inflation (Simpson et al., 2005: Hsing, 2007), money supply (Hushmand et al., 2012), and Net trade (Gondaliya and Dave, 2015), ware found inconclusive findings and therefore no clear consensus is provided to explain the relationship between Exchange rate and oil price with other economic indicators. Plethora studies have been conducted on financial variables such stock market index (Bhattacharya and Mukherjee, 2003), Interest rate (Kanas, A., 2005) and many others and yet there are no solid clear consensus findings pertaining its relationship.

There are numbers of scholars have examined the influence of inflation, interest rate, money supply, net trade and stock market towards the exchange rate. However, less attention is devoted to the impact of oil price movement in the exchange rate market by incorporating the economic, finance and US factor to the model. The impact of oil price can be further explained by the Law of One Price theory, which was introduced by Blomberg and Harris (1995). The theory suggested that the linkage between the exchange rate and oil price volatility is justified when the international market is efficient and no barriers of trade. Furthermore, the same product that will be sold at the same common-currency price in different nations. Therefore, this study attempts to investigate whether the oil price effect exchange rate alone or indirect effect with a presence of both macroeconomic and financial factors.

Despite of plethora studies on oil prices are concerned, issues on the gap pertaining to its relationship towards an exchange rate are still questionable among the scholars. Most of the literature ware focused either on single or several oil-importing and oil-exporting by using time series data or panel data. Previous literature also focused either using economic and financial variables separately. The literature generally concentrates on this area, in fact, the link between oil price and exchange rates is influenced by economic variables and financial variables. In addition to these factors, the researcher also considers US factor as proposed by Yang et al., (2017), since both of crude oil prices and exchange rate are quoted based on US dollars. Thus, this study is expected to contribute the body of knowledge, where this study includes oil price to the model and incorporating the financial, economic variables and US factor to the model.

Theoretical Review

The Law of One Price

Blomberg and Harris (1995) introduced the Law One Price (LOP) theory that can be utilized to explain the linkage between the exchange rate and oil price. The international market must be efficient, no barriers of trade and the same product will be sold at the same common-currency price in different nations. US dollars is usually used for the crude oil price.

According to Yang et al., (2017), the LOP can be expressed as:

$$P^* = e + P \quad (1)$$

Where;

P^* = oil price in units of foreign currency

e = nominal US dollar exchange rate (foreign currency per unit of US dollars)

P = oil price in US dollars

Equation 1 presents, the crude oil price in the foreign country would decrease due to a decrease in e (nominal US dollars exchange rate), a decrease in the foreign currency would increase the crude oil price in the US dollars. While the remote money devalues to the US dollar. Rise in the crude oil price in the US dollars would lead to purchasing power and oil demand of foreign consumers increase.

In general, the price of goods is made up of traded and non- traded goods. The home and foreign countries consumer price indexes can be Illustrated as follows;

$$p = (1 - \psi)\, pT + \psi p^N \quad (2)$$

$$p* = (1 - \psi *)\, p^* + \psi^* p^{N*} \quad (3)$$

Where;

$p^T(p^{T*})$ and $p^N(p^{N*})$ = Price of traded and non-traded goods for home country

(ψ^*) = weight of the expenditure share of non-traded goods in the home country

The nominal exchange rate can be constructed by Combining Eqs. (1) to (3).

$$e = (p^{N*} - p^N) + (1 - \psi^*)(p^{T*} - p^{N*}) - (1 - \psi)(p^T - p^N) \quad (4)$$

When weights of the expenditure share of non-traded goods ($\psi \approx \psi^*$) is similar in the home and foreign country, same goes to the changes in the oil price of non-traded goods in the home and foreign countries caused by the cost-push effect. The effect of oil price can be seen by the home country price of traded goods is corresponding to the relative price of traded goods in a foreign country. In this way, an increase in the oil price could raise the relative price in the home country if it's oil-importing country and to a greater extent than the price of traded goods in the foreign country. Therefore, the home country would experience depreciates. Conversely, an increase in oil price causes the home currency to appreciate

if the home country is an oil-exporting country. Effect of oil price on exchange rates can be rebuilt by included Is this part of the financial variables into the model to form an alternative model. Assume m(m*) is the nominal demand for money in the home (foreign) country dependent on the price level p (p*), real income y(y*), and interest rate i(i*). From both home and a foreign country, assume that the effect these three variables on money demand is similar, based on the interest rate parity condition, Eq. (1) can be reconstructed to represent the nominal exchange rates:

$$e = (m* - m) + (y - y*) \quad (5)$$

Eq. (5) obliges crude oil price as an extra-logical variable to clarify its impact on the exchange rate (Lizardo and Mollick, 2010). This model can likewise be considered as a basic long-run monetary model for exchange rate determination. Consequently, by treating oil-importing country and oil-exporting country differently the researcher can examine the dependence structure at the reliance structure of the crude oil price and the exchange rate at different circumstances.

Literature Review

Some early studies on oil prices and exchange rate have been discovered by the Amano and Van Norden (1998). The study claimed that both oil importing, and oil exporting countries seemed to support the relationship between oil prices and exchange rate in the long run. These findings also are consistent with both theories developed by Krugman (1983) and Golub (1983), Another prominent study develops by Yang et al (2017) have used a robust analysis using wavelet coherence analysis and found not consistent results as prescribed by both theories. Based on this study Mixed findings can be generated as the oil exporting countries produce negative in the relationship between oil prices and exchange rate, meanwhile, the oil importing countries showed uncertain relationships. Interestingly, another latest study conducted by Ahmad and Hernandez (2013) and Lizardo and Mollick (2010) revealed that the effect on exchange rate can be found only in oil exporting countries and not for the oil importing countries, another justification the absence of its relationship is due to different approaches in assessing its relationship as mentioned by Buetzer et al (2012)

As stated earlier, economic variables were also can be considered as the contributor for the direct effect of exchange rate movement. An established paper published by Simpson et al (2005) dictated that when both oil-importing and oil-exporting countries would be having a similar direction and remain the low level of the inflation rate, the domestic country will experience appreciate the exchange rate. The monetary policy tools can be determined using the interest rate (Dominqueez, 2006) which also is yet to a general conclusion. Mc Pheron and Rakovski (1998) found no relationship between Interest rate and exchange rate using vector autoregressive model (VAR) in Kenya while a study conducted by Husmand et al (2012) dictated that Interest rate has a positive relationship with the exchange in the long run and short run effect using lag monetary policy. An opposed finding, can be seen in the studies conducted by Rahman and Uddin (2009) and Bhattacharya and Mukherjee (2003) with no relationship between interest rate and stock market index in south Asian countries and these studies also supported study by Yang et al, (2017) which the result is consistent in the finding.

Data and methodology

The main data consists of oil prices and the exchange rate based on selected oil importing (Japan, China, and India) and exporting (Russia, Canada, and Malaysia) countries. Other variables such as the economic (Money supply, Inflation, and Net Trade), financial (Interest rate and Stock Market) and US factor (Implied Volatility Index) are used in this study using data stretching from August 2005 to December 2016 in monthly basis. The sample selection selected based on the highest importing and exporting oil countries, except Japan and Malaysia. The researcher distinguishes between oil importing and oil exporting countries in the dataset as Eq. (4), which shows the currency in the oil-dependent countries reacts more sensitively to the changes in oil price (Yang et al., 2017). The dataset contains monthly data observations from August 2005 to December 2016, expressed in percentage data to obtain a return series for comparison of the finding. The data obtained from DataStream, FredEconomicdata, Data Stream and Bloomberg. Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) test unit root test was used to determine the order of integration of the variables used in the analysis and to avoid the spurious

results. Besides that, Ramsey reset test show the p-values are not significant at 5 percent level which indicates the data are correctly specified and OLS estimation can be used.

In regressing multiple regression or simple models, Ordinary Least Square (OLS) can be carried out to run the model constructed. The lease square function is created to identify the relationship between the dependent variables and independent variables. The relationship can be expressed as below:

$$Y_t = \beta_0 + \beta_1 Z_{1t} + \beta_n X_{nt} + \varepsilon_t \quad (6)$$

Where Y_t is exchange rate, Z_{1t} is represented of focus independent variables which are oil price, X_{nt} is the others factor that explains the exchange rate, which is inflation, money supply, net trade, interest rate, stock market index and implied volatility index. β_0 represent constant parameters and ε_t are the error term. The sign of coefficient β_{nt} are expected to be positive, in the regression analysis, monthly data will be used in order determining the regression coefficients. The Empirical model developed by the researcher is contrasting with the others published researches such as Yang et al. (2017) and Volkov (2016). The researcher includes economic and financial variables as the independent variables which include Inflation, Net Trade, Money supply, Interest rate, Stock market price, Implied volatility index and main independent variables Oil price. The coefficient sign of oil price is expected to be positive for oil importing which indicate depreciate in domestic currency, while for oil-importing the sign expected to be negative. This is due to the demand for foreign currency will increase if the price of oil increase then the domestic currency theoretically should depreciate for oil importing countries. Thus, if the sign of the coefficient is positive and statistically significant it will imply that the domestic currency will depreciate.

Data analysis and empirical results

The general findings suggest that all the variables stationary at level, except for China variables which are Interest rate, Money Supply, and Stock market index that stationary at first order different. The diagnostic check result indicates the data suffer from serial correlation, heteroscedasticity. Thus, the researcher using the HAC(Newey-West) covariance method in order to treat the problems. Besides that, Ramsey reset test confirm that the variables are correctly specified.

	Oil-Importing			Oil-Exporting		
Country	Japan	China	India	Russia	Canada	Malaysia
Variables	Coefficient					
Inflation	0.2253	0.0243	0.1136	1.7878***	0.0038	-0.0030
	(-0.5575)	(0.0772)	(0.1287)	(0.7635)	(0.3730)	(0.0033)
Money supply	-51.5182***	0.0134	-0.2324***	0.0140	0.9672**	-0.0025
	(-4.3751)	(0.0231)	(0.0744)	(0.0958)	(0.3816)	(0.2013)
Net Trade	-0.0023	0.0091**	0.0051	-0.0154	0.0006	0.0002***
	(-0.0038)	(0.0041)	(0.0316)	(0.0131)	(0.0013)	(0.0001)
Interest Rate	-8.3100	-0.1494	0.0535	0.0358	-0.0091	-0.0028
	(-0.0008)	(0.3236)	(0.0279)	(0.0331)	(0.0095)	(0.0117)
Stock Price	1.9163	-1.6607	-3.1735	0.0840	0.0283	-0.2171***
	(-5.4602)	(1.7252)	(2.9634)	(0.0721)	(0.0367)	(0.0578)
Implied V.	-0.0620	-0.0114	0.0920**	0.1077	0.1897***	0.0001
	(-0.0515)	(0.0084)	(0.0357)	(0.0968)	(0.0373)	(0.0006)
Oil Price	0.0037	-0.0167**	-0.0327*	-0.2693***	-0.1045***	-0.0002
	(-0.0213)	(0.0071)	(0.0160)	(0.0477)	(0.0169)	(0.0002)
C	0.3053*	-0.0941*	0.5000	-0.6795	-0.4744*	0.0040*
	(-0.1776)	(0.0857)	(0.3646)	(0.5344)	(0.2679)	(0.0024)
R-squared	0.5576	0.083935	0.3944	0.4242	0.5428	0.2604
Adjusted R-squared	0.5336	0.033837	0.3615	0.3930	0.5180	0.2203
F-statistic	23.2305***	1.675435*	12.0015***	13.57712***	21.8777***	6.4881***

Notes: ***, **, * Indicates significance at the 99%, 95% and 90% level. Standard error is given below the coefficient the parenthesis.

Table 4.1: Results of Regression for Both Oil Importing and Oil Exporting Countries. Dependent variable: Exchange Rates

Table 4.1 shows the result of the OLS regression analysis for both oil exporting and importing countries. The coefficient sign for oil prices in most sample shows a negative relationship between the oil prices and exchange rate in both oil importing and exporting countries and significant at 99% confidence level except for Japan and Malaysia respectively. A negative sign implies that an increase in oil price will lead to appreciate in the exchange rate in domestic currency for both oil importing and exporting countries. R-squared for all sample is between the range 0.8 to 54.28 percent and consider as low power of explanatory due to other omitted of other independent variables.

Discussions and conclusions

This paper attempts to determine the relationship between the oil price and exchange rate by incorporating the economic, financial and US factor into the estimated model. The theoretical perspective explains that the role of oil prices in explaining exchange rate movements was introduced by Golub (1983) and Krugman (1983) is intertwined by its relationship in nature. Golub (1983) and Krugman (1983) explain that oil prices rise in the oil-exporting country may experience appreciation, while for the oil-importing country may experience depreciation in the currency. However, there was contradict result between oil exporting countries and oil importing countries, where all oil-importing countries (Russia, Canada, and Malaysia) consistent with the theory but surprisingly two of oil-importing countries (China and India) are not following the theory except Japan. This study consistent with Yang et al, (2017) where the impact of oil price on the exchange rate is negative for oil exporting countries and for oil-importing countries there is an uncertain relationship. The impact of oil price on the exchange rate is positive for Japan while China, India, Russia, Canada, and Malaysia there was a negative that indicates increase in oil price the currency will appreciate caused by wealth transfer from oil-importing countries, since coefficient sign for Russia, China, and Malaysia have found negative, the result consistent study by Akram (2004) where the oil-exporting country which is Norwegian experience depreciation in the currency when the oil price increase. In addition, a study by Yang et al, (2017) found that oil price is a significant factor in determining the exchange rate as stated in table 4.1, and there was a negative relationship between oil price and the exchange rate for oil-exporting countries. However, the relationship is weak for Japan and Malaysia, this is because the dependency on Crude Oil is less for these countries. Increase in oil price will cause–the China and India currencies to appreciate which is against with existence theory, this is due to, these countries revalue its currency in order to gains the purchasing power because of these countries are the highest oil-importer in the world. Apart from that, it can be assumed that since the net trade show a positive sign the currency will be depreciated. However, by theory if the export increases the currency should be appreciated, however, the currency is depreciated, this is because those countries wanted to increase the level of its product competitiveness in the trade market. This result indicates that these countries control their currency in order to gains the benefits from the trade market. Thus, it can be concluded that the findings on the intertwinement impact of oil price toward the exchange rate would give a practical implication to policymakers and traders in terms of designing the effective fiscal policy and monetary policy for both oil-exporting and oil-importing countries.

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